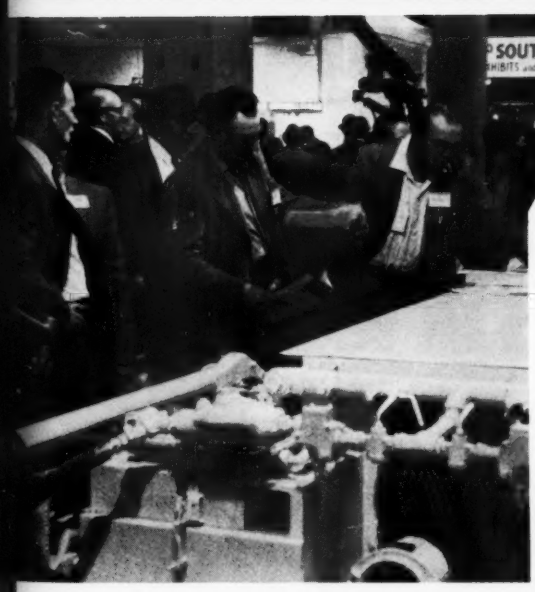
MINING CONGRESS JOURNAL



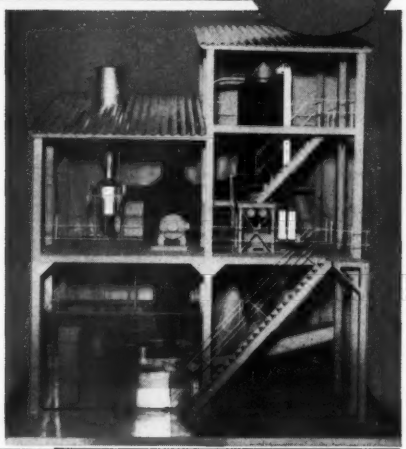
1959 AMC Coal Show Report

See full story pages 69 to 81

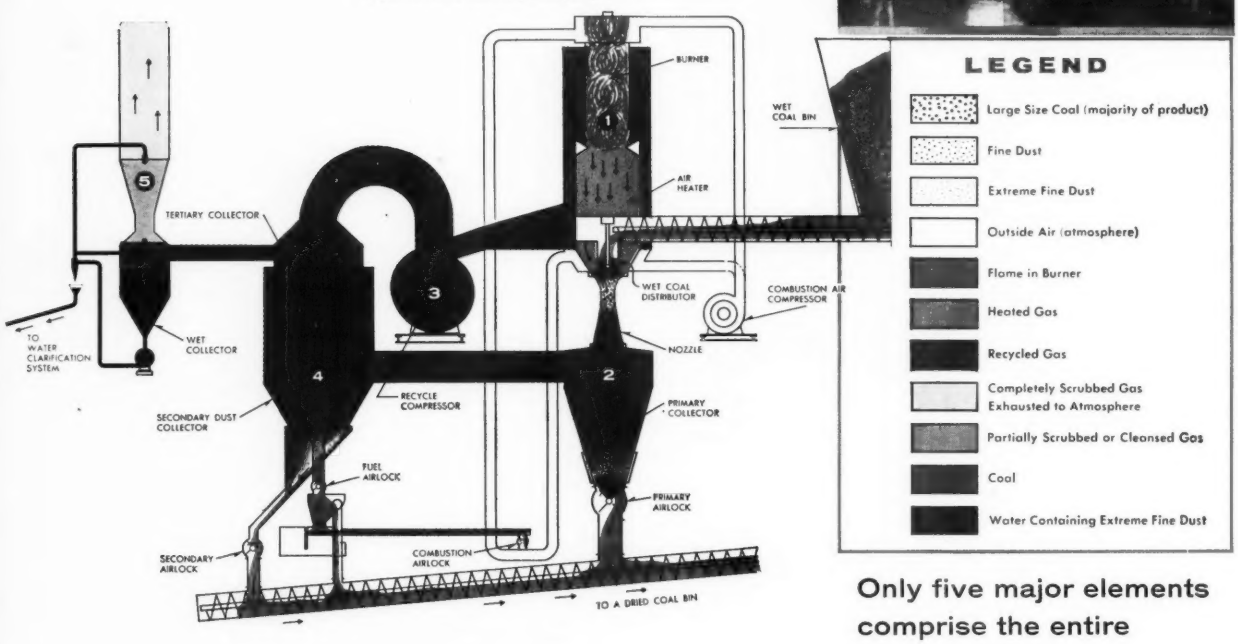
NOW... SAFETY... ECONOMY

at High Thermal Efficiency and Low Product Temperature

FAIRMONT-built TAILOR STREAM-FLO THERMAL DRYER*



*Tailor Stream-Flo Thermal Dryer is the trade name for thermal dryers of Tailor and Co., Davenport, Iowa.



Surface moisture removed from coal and other solid materials without threat of explosion and internal fires!

This revolutionary achievement is accomplished by the new Tailor Stream-Flo Thermal Dryer that combines continuous pressurized drying at high thermal efficiency and low product temperature. Inert atmosphere, pressurized by a compressor system, assures non-turbulent action that is safe and economical.

The new Tailor Stream-Flo Thermal Dryer operates by gravity, dries feed products instantaneously up to 2" . . . recovers the finest dusts easily and effectively.

Only five major compact elements comprise the new Tailor Stream-Flo Thermal Dryer. Simplicity of their design eliminates costly auxiliary equipment, including ash removal and handling units; holds space requirements to a minimum; drastically reduces maintenance and repair.

Only five major elements comprise the entire Dryer system:

1. burner-heater with combustion air duct assembly
2. drying nozzle and primary collector
3. recycle compressor
4. secondary and integrated tertiary dust collectors; and
5. wet collector and exhaust duct for scrubbed gas

FAIRMONT MACHINERY COMPANY
FAIRMONT, WEST VIRGINIA

MINING CONGRESS JOURNAL

VOL. 45 JUNE 1959 NO. 6

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Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

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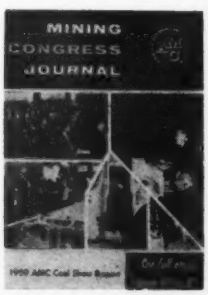
ON OUR COVER

Thousands of mining men converged on Cleveland to attend the 1959 AMC Coal Show. For the full story see pages 69 to 81.



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A new mining pattern in low coal the JOY ROTOBUSTER

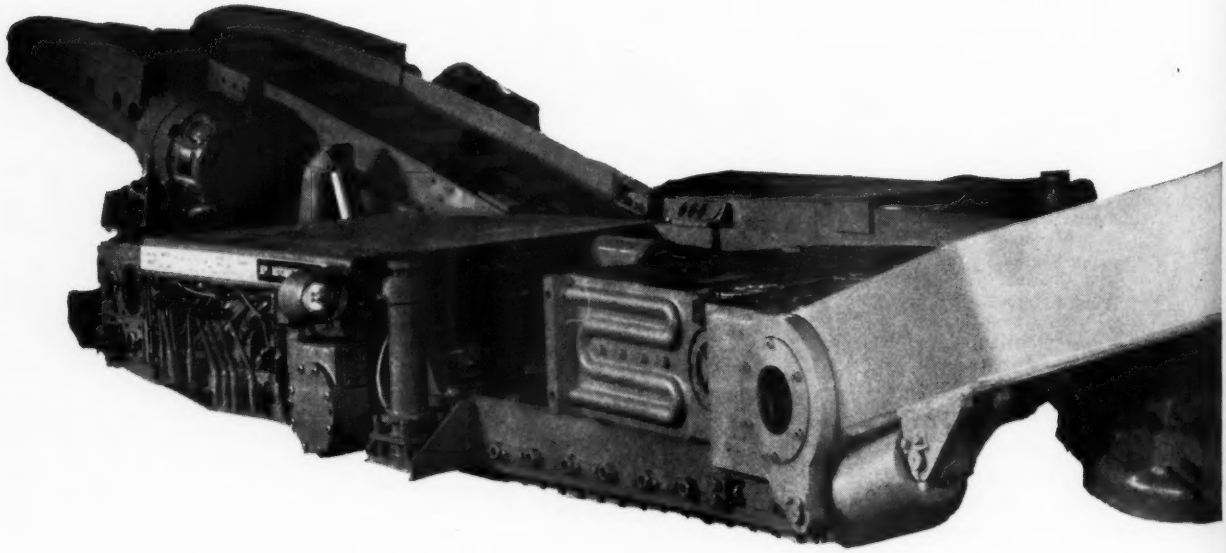
Here's a new kind of continuous miner designed for seams as low as 32 inches. The Joy Rotobuster works on a new and different mining principle to mine rooms 14 to 20 feet wide in seams 32 to 48 inches high.

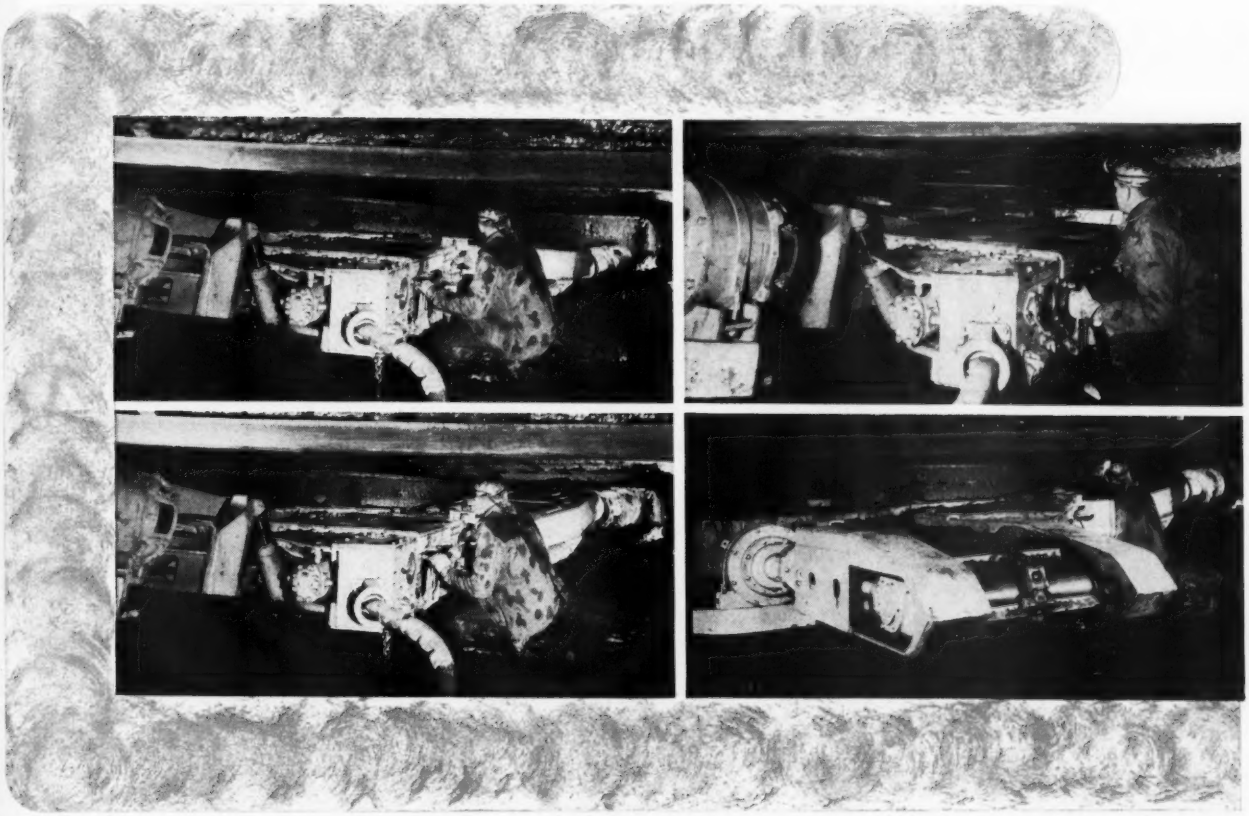
The Rotobuster works this way: the mining head bores into the coal, then sweeps sideways across the face breaking out the coal in its path. When the head reaches the opposite rib it shears upward, then begins a return sweep back across the face. This completes the mining cycle, and the Rotobuster begins a new cycle by sumping forward on its crawlers. Simple . . . and fast.

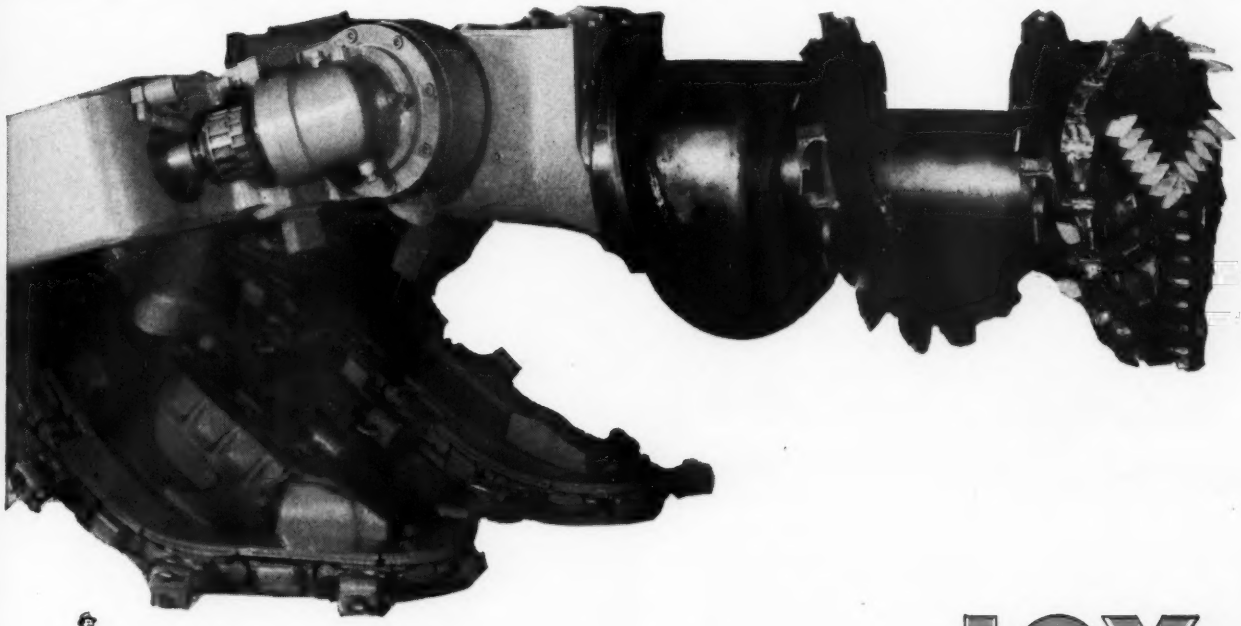
The operator follows the seam by selecting the cutting height and width as he mines each cycle—no need for adjustment. Fallen coal is swept into the conveyor by two loading chains. These chains and the front end of the conveyor swing with the mining head for complete and efficient cleanup.

The mining head, resembling a 26″ dia. auger, is actually two separate cutting devices rotating in opposite directions at different speeds about a common axis. In front is the end cutter that cuts a slot in the coal. The second element, an auger-like cutter, breaks the coal into the slot and moves it back to the conveyor.

The Rotobuster's head swings 45° to either side, and the conveyor also swings 45° to either side. This means unmatched maneuverability and versatility in driving crosscuts and mining wide rooms in low coal. For complete information on the Joy Rotobuster write for bulletin 22-3







WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING MACHINERY

JOY

Coal Drills	Coal Loaders	Coal Cutters	Shuttle Cars	Continuous Miners

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Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

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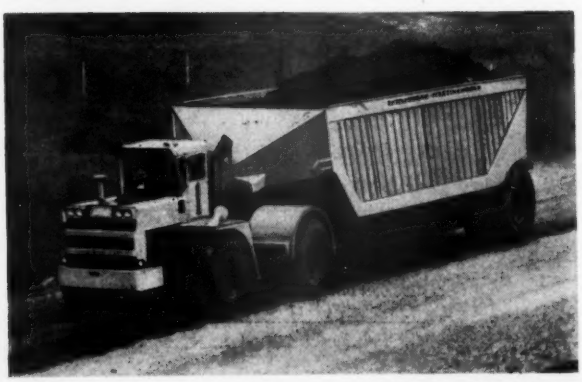
Introduced at the COAL SHOW...

LW-80 HAULPAK®

80 tons



*Trademark HPC-2142-M-2

Now ready to cut your haul costs

of coal at 40 MPH

Brief Facts: 80-ton, 100-cubic yard capacity . . . 450-hp Cummins V-12 diesel engine . . . Allison transmission and torque converter . . . Four forward speeds to 40.1 mph; two reverse to 7.8 mph . . . Ten 18.00-33, 32 PR tires . . . Full time hydraulic power-assist steering . . . 6,552 sq in. of brake surface . . . Approx. 73,000 lb empty weight, 233,000 lb loaded weight.

Most profitable coal hauler ever made . . . the LW-80 moves 80 tons of payload at 40 mph. Apply those figures to your own operations, see what a difference they make on your cost sheets. This outstanding new coal hauler offers these features:

- Exclusive Hydrair* wheel suspension on all wheels
- Multiple-disc air brakes
- Sealed-for-life bearings—only four grease fittings
- Hydrair trailer hitch
- Exclusive power-transfer differential
- Air-actuated bottom-dump doors
- Trailer construction of high-tensile-strength steels
- Lowest center of gravity for greater stability

If you're ready for MAXIMUM efficiency in your coal handling, see your LW Distributor or write us for full information.

LW

Where quality is a habit

LETOURNEAU-WESTINGHOUSE COMPANY

Peoria, Illinois

A Subsidiary of Westinghouse Air Brake Company

3 new applications get longer life and minimum maintenance using Dodge pillow blocks with Timken® bearings

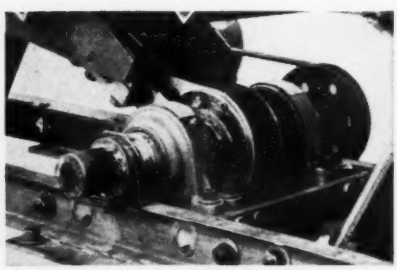
PICTURED below are three applications where Timken bearing equipped Dodge pillow blocks stay on the job with little attention under tough conditions. Their tapered design lets Timken® bearings take *both* radial and thrust loads in any combination. And full-line contact between rollers and races provides extra load-carrying capacity. Wear is reduced, maintenance is cut to the minimum.

Cutaway view shows the Dodge All-Steel pillow block with Timken bearing mounting. Of special design, the bearing has a tapered bore with self-aligning spherical outer surface —never needs adjustment.

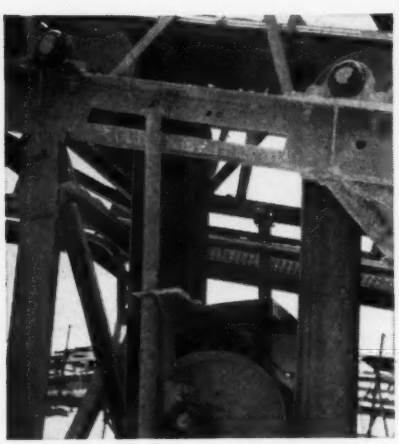
Besides the All-Steel pillow block, other versatile Dodge pillow blocks with Timken tapered roller bearings are: Type "E", Double-Interlock, Type "C" and Special Duty. All are compact in design. Special thrust devices that take up extra space are not needed.

Timken bearings bring Betterness to any machines because Betterness rolls on Timken *tapered* roller bearings. So specify bearings trademarked "TIMKEN" for the machines you buy or build. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



Timken bearing-equipped Dodge All-Steel pillow block used in a vibrating conveyor.



Timken bearing-equipped Dodge Type "E" pillow block used in sand and gravel plant.

Timken bearing-equipped Dodge "Special Duty" pillow block as used on fine paper machine lineshafts.

TIMKEN TAPERED ROLLER BEARINGS ROLL THE LOAD

TRADE-MARK REG. U. S. PAT. OFF.

Three diamond turnouts to feed the Rotary Dump

This "topside" track layout in West Virginia is a marvel of operating efficiency. It features three diamond turnouts which feed the rotary dump, and a three-way turnout at the discharge end to return the empty cars to the mine.

Ingenious layout design and well-built special trackwork were the factors that made this setup possible. Bethlehem engineers worked closely with the customer in planning and designing the layout, and Bethlehem shops prefabricated the trackwork.

This is a fine example of Bethlehem engineering teamed with forward-looking mine management to produce money-saving results. Perhaps there is room in your haulage system for "the Bethlehem approach." Our engineers will gladly visit your workings to discuss your problems. Just put in a call to our nearest office, or drop us a line direct.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

5 Big Advantages of EUCLID'S TC-12 Twin-Power Crawler

Functional "years ahead" design, combined with unequalled power, makes the new series TC-12 the best all-around performer in the big tractor field. Its big power and big performance helps beat the pinch on profits...on every kind of big tractor work. Check these cost-cutting features:

Twin Engines with a total of 425 net horsepower . . . separate Torqmatic Drives each consisting of torque converter and semi-automatic transmission...more workability for heavy dozing, ripping, push-loading and towing than any other "super" tractor.

Independent Track Drives give the big TC-12 almost unbelievable mobility and maneuverability. With its separate power train and Torqmatic Drive, each track can work all the time because its power and speed is individually controlled. Operator has immediate, positive control for quick turns and side slope work.

Rigid Track Alignment is constantly maintained because each track is positioned to its main frame...each half of the tractor oscillates on a big diameter transverse shaft which provides maximum traction in rough going and increases track life. The tractor can be easily split into two halves for transport from one job to another.

Fast, Easy Operation is achieved by the separate Torqmatic Drives and simple controls. There's no master clutch...changes from one speed range to another are made under full power. Excellent visibility front and rear, and comfortable operator's seat, help to increase productive capacity. Good machine balance and stability, and "fast on its feet" performance, make the TC-12 unequalled for any big tractor work.

Service Accessibility that cuts downtime to a minimum is a feature of TC-12 design. Unitized assembly of converter, transmission and drive case components permits fast servicing or replacement without major tear-down of other parts. For example, both drive sprockets can be removed or replaced in about one-third the time required for the same work on a competitive big tractor. Planetary final drives can be serviced without breaking track or pulling sprocket.

Whatever the job, if it's a big tractor application the Euclid TC-12 will bring the best return on investment... the Euclid dealer in your territory can prove it!

EUCLID Division of General Motors, Cleveland 17, Ohio

GM GENERAL MOTORS EUCLID

EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE

TANK CAR DELIVERY OF MOLTEN SULPHUR

Loading Tank Cars at one of our mines

...an important phase of TGS Service

This is a service of interest to the rapidly increasing number of companies preferring to receive their sulphur deliveries in molten form so that they can transfer directly from cars into consumption. We are equipped now to deliver molten sulphur by tank car from all mines and recovery plants to any place in the country. Detailed instruction sheets and drawings are available on request for those in the planning stage or who do not have adequate or proper facilities for handling and storing molten sulphur.

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Sulphur Producing Units: Newgulf, Texas • Spindletop Dome, Texas • Moss Bluff, Texas • Fannett, Texas • Worland, Wyoming •

A NEW PLANT

...for BELL & ZOLLER COAL COMPANY

Designed, Engineered and Built by

Roberts & Schaefer

Bell & Zoller chose Roberts & Schaefer to build their new plant for the same reasons it will pay you to do so. You'll find at R&S an understanding appraisal of your problem, long experience and an outstanding record of performance. You can depend on R&S for complete design and engineering services, and efficient facilities for installation and construction. Perhaps, most important of all, you'll have the comfortable feeling that, with Roberts & Schaefer on the job, you can be sure you'll get a plant with the capacity, flexibility, efficiency and economy of operation you want.

ENGINEERS & CONTRACTORS

ROBERTS & SCHAEFER Company

130 NORTH WELLS STREET, CHICAGO 6, ILLINOIS

NEW YORK 19, N.Y. • PITTSBURGH 22, PA. • HUNTINGTON 10, W. VA. • ST. PAUL 1, MINN.

THE NEW BELL & ZOLLER ZEIGLER NO. 3 MINE

Bell & Zoller's 3-way washing and processing plant, at Zeigler No. 3 mine in Southern Illinois, combines three distinct coal cleaning methods in a single installation: Roberts & Schaefer Dutch State Mines Heavy Medium Washer, R&S Air Flow Cleaner, and Baum Jig Washer. As a result, the entire output of the mine will be processed through the new plant, delivering Zeigler coal as a more thoroughly cleaned product in all sizes and consists.

It pays to talk with Roberts & Schaefer

Now you can bolt soft mine roofs

SAFELY,

with PATTIN'S revolutionary, new *AIR SEAL resin process...

CHECK THESE FEATURES —

- **Resin penetrates soft shale around expansion shell, seals out air and prevents crumbling of sidewalls where shell is anchored.**
- **Binds shell and strata together into one solid mass at anchoring end of bolt.**
- **Absolutely permanent anchorage — impervious to oxidation, water, oil, gas or acids. Ideal for haulageways and airways which must remain open for many years.**
- **Extremely strong adhesion value, even on wet surfaces — high tensile and compression strength.**
- **Resin is pre-packaged in convenient container — no spilling — no contact with workman.**

***U. S. Pat. No. 2,829,502. Other patents pending in the U. S. and foreign countries.**

Mine operators have long sought a simple and safe solution to the problems of bolting in soft, failing roofs. After many years of research and in-the-mine testing, Pattin has perfected this revolutionary and completely different AIR-SEAL resin process. This patented method, designed for use with expansion shells and bolts, features an air sealing plastic resin in a special container. Each container holds the exact amount of resin needed for one bolt hole.

The process requires no special equipment for use. The container is simply inserted into the bolt hole ahead of the expansion shell and bolt, and pushed into place. The container is crushed between the shell and the end of the bore hole when the bolt is in place and tightening begins, releasing the plastic resin to flow over, around and into the shell and surrounding strata. It cannot run down the bolt, due to sealing washers and an expanding gasket under the shell. The resin solidifies quickly into a tough, adhesive mass, due to fast-acting chemical action. The tremendous holding power and permanence of this new process multiplies the effect of a regular bolt and shell many times and secures the anchorage for many additional years.

Our service engineers are always available for consultation and demonstration of this unique Air-Seal process, or for any other roof bolting problem. Write, wire or phone us TODAY!

AIR SEAL RESIN CONTAINER

IN WESTERN STATES

Pattin expansion shells and Air-Seal process are available and serviced exclusively by The Colorado Fuel and Iron Corp., Denver, Colorado. Western mining companies should contact them direct for information and consultation.

The PIONEER of roof bolting . . . established 1888

PATTIN

MANUFACTURING COMPANY
MARIETTA, OHIO

NOW

NEW BATTERY PLATE CONSTRUCTION

Unique new double-sleeve, multi-tube positive plate construction permits greater volume of active material per tube and greater accessibility of electrolyte to the material — providing greater capacity for brighter, better light with no increase in plate size. Long battery life with increased resistance to vibration and hard use are plus advantages.

A PERFECT SPOT

at your fingertips — either filament!

A finger-turn of the switch knob lights either filament of the powerful equal-filament bulb—and at the same time achieves a perfect, brilliant spot! No tools, no fuss or tinkering. Anyone who can turn a switch can focus an ideal spot with WHEAT—instantly!

— a MAJOR ADVANCE

in better light for the miner!

THE WHEAT National MODEL

MINER'S ELECTRIC CAP LAMP

In a single step, WHEAT moves out front in better light, greater utility, top service for the worker underground! The WHEAT *National* Electric Cap Lamp incorporates advances in battery, bulb and focussing beyond comparison in the field today—retains every factor of dependability, simplicity and ease of maintenance that have made WHEAT the leader in sales increase for the past decade. See your National Mine man now, and talk WHEAT NATIONAL for its very good reasons!

30% MORE LIGHT

at no increase in weight

Advanced, exclusive new battery construction joins with efficient new krypton-filled bulb to achieve unrivalled light output in a miner's electric cap lamp today . . . 30% more light than even the high-powered Wheat Forty-niner! For the *most* light for the miner throughout the working shift, specify WHEAT NATIONAL.

TWO WORKING FILAMENTS

in Krypton gas-filled bulb

Each of the two identical filaments in the new Wheat krypton-filled bulb is a full-power working filament. If one burns out, the other is instantly available at equal high brightness—and is focussed instantly to an equal perfect spot. Only WHEAT NATIONAL offers this operating ease!

National Mine Service Company

Koppers Building Pittsburgh 19, Pa.

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A completely NEW...vastly IMPROVED method of SHUTTLE CAR-TO-BELT FEEDING

THE RATIO-FEEDER

- Receives coal from shuttle car at car's maximum discharge rate.
- Feeds coal to belt at a slower, controlled, uniform rate.

LOWERS YOUR COST PER TON

The Ratio-Feeder is a chain flight conveyor employing two converging CM Alloy Steel Link Chains. The sloped hopper stores the full shuttle car load and meters the coal at a uniform rate to the belt. Feeder empties gradually from intake end but fast enough to take full load of following shuttle car.

Six Standard Models—Capacities from 2¼ to 9 tons. Larger Capacities to Order.

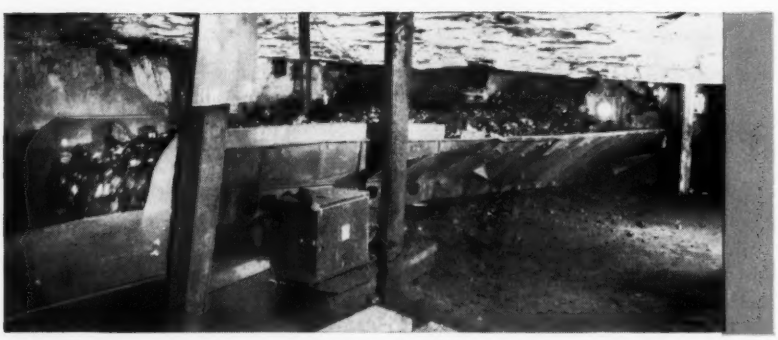
- **PAYS FOR ITSELF IN AS LITTLE AS SIX MONTHS IN DIRECT LABOR SAVINGS ALONE**
- **ALREADY PROVED AND AT WORK IN MINES IN VIRGINIA, KENTUCKY, WEST VIRGINIA AND OHIO***

The Ratio-Feeder is an entirely new concept in shuttle car to belt feeding. It is the first feeder to incorporate ALL the characteristics necessary for true, all-around performance as a belt feeder. Overall savings are the result of one or a combination of the following features...apply them to your mine and see for yourself how much Ratio-Feeder can lower your cost per ton.

Cuts Shuttle Car Discharge Time increasing haulage capacity and sectional output or extending shuttle car haul distance, increasing room work and reducing move-ups and their costs.

Increases Belt Hauling Capacity. Continuous uniform loading permits more sections to feed a belt increasing mine productivity or it allows you to use smaller, less costly belts.

Eliminates Spillage and Belt Damage. Gentle, controlled loading reduces belt repair costs and increases their life. Even slate and rock can be loaded without damage. Clean-up costs for spillage are practically eliminated, too.



RATIO-FEEDER at work in Reppert Fairmont mine. Feeder provides elevation to belt eliminating shuttle car booms and their costs. It eliminates conveyor misalignments caused by shuttle cars bumping belt structures. Feeder can be moved by a shuttle car or loader. Large ramps are eliminated as is most roof taking.

CM Alloy Steel welded link-type chain, case hardened and with a material tensile strength of 150,000 p. s. i. drives the Ratio-Feeder flights. This elementally simple, flexible, rugged type of chain has the superior wear, abrasion and break resistant properties required for severe mine service.

WRITE FOR BULLETIN 100

*Locations on request

CM MINE EQUIPMENT

COLUMBUS McKINNON CHAIN CORPORATION

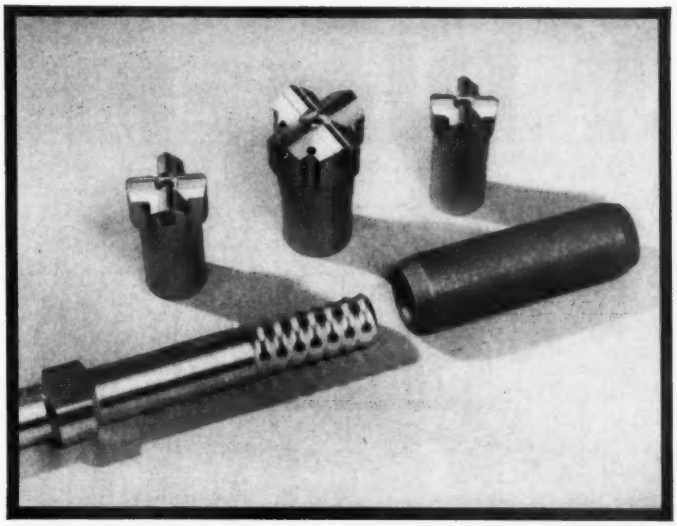
Mining Equipment Division

TONAWANDA, NEW YORK

Manufacturers of **CM HOISTS, CHAIN AND CONVEYORS**

Ratio-Feeder—TM Pat. Pend.

- ***MATERIALS HANDLING EQUIPMENT SPECIALISTS FOR 75 YEARS***



Here's proof Coromant rope-thread bits and steels SAVE TIME AND MONEY

"Up to double the footage between sharpenings!"
"Premature rod breakage is almost non-existent!"
"40% more usable life—more resharpenings!"
"Bit and rod life are well above average!"
"Uncouple by hand all the time!"
"More rigid—drills straighter holes!"*

**Names of men quoted available on request*

The comments above are actual quotes from project managers, job superintendents, and drill superintendents who have tested new Coromant rope-thread bits and steels. They've learned, on-the-job, the benefits they—and you—can expect!

For example: The new rope-thread (only two turns per inch) holds tight in use, yet permits hand uncoupling. Reports show that the time saved results in more footage drilled per shift. Bit footage is well above average too, with less loss of carbide inserts. Prime quality ore plus nickel-chrome alloy permits cold-rolling from billets for greater strength, life and rigidity. And only with Coromant rope-thread steels can you re-thread without heat treating, too. Do it yourself, or at any nearby machine shop.

Want to know more? There's no obligation on your part, but we'll be glad to help where we can. Just call your nearest Atlas Copco Office, or write to us at Dept. MCJ-7.

Atlas Copco

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Paramus, New Jersey
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930 Brittan Avenue
San Carlos, California
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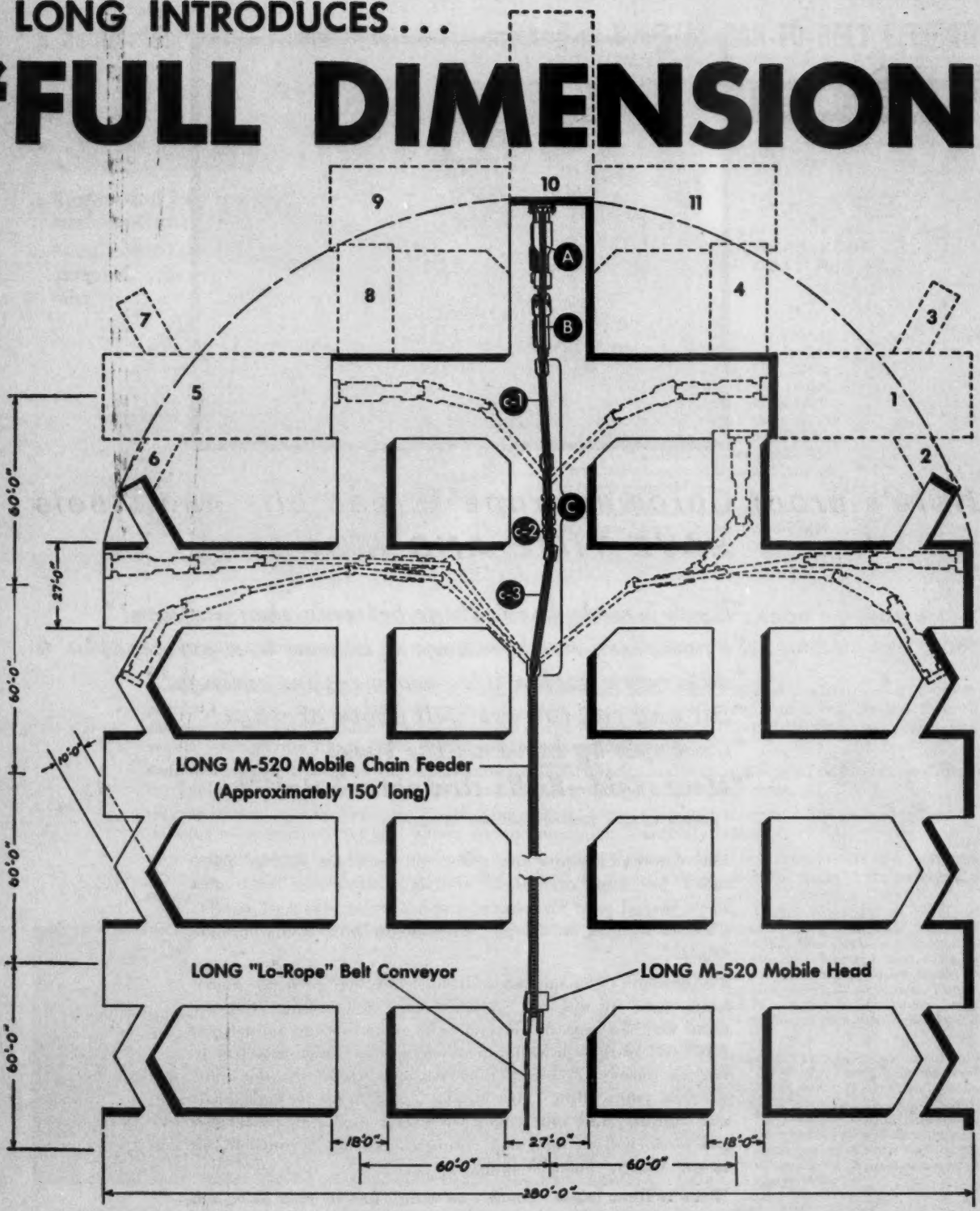
LONG INTRODUCES . . .

"FULL DIMENSION"



Coal is mined by a continuous mining machine followed by a LONG 188 Loader. Behind the loader is the three-unit mobile bridge, which feeds on a mobile chain feeder approximately 100-150 feet long. Coal is moved from the mobile chain feeder to a LONG "LO-ROPE" Belt Conveyor, which may be driven by a mobile crawler mounted head section and which is equipped with a "HY-WINDER" belt winding station.

Extensibility of the "FULL DIMENSION" Conveyor System during operation is provided by the movement of the second Piggyback on the mobile chain feeder a distance of up to 150 feet, plus the movement of the first Piggyback on the mobile bridge carrier a distance up to 20 feet. Extensions or retractions of the belt conveyor are made at breakthrough intervals, usually 50 or 60 feet.

Equipment Designation (*See Diagram*)	Effective Length
A. Continuous Mining Machine	30'0"
B. LONG 188-D Loader	22'0"
C. 3-Unit Mobile Bridge includes:	
c-1 LONG PT-218 Piggyback Conveyor	32'2"
c-2 LONG Mobile Bridge Carrier	25'8"
c-3 LONG PT-218 Piggyback Conveyor	38'8"
Coal Trajectory From Miner (Not shown)	2'0"
Total Effective Length	**150' 6"**

'MINING —THE FIRST AND ONLY

EXTENSIBLE CONVEYOR SYSTEM THAT OFFERS:

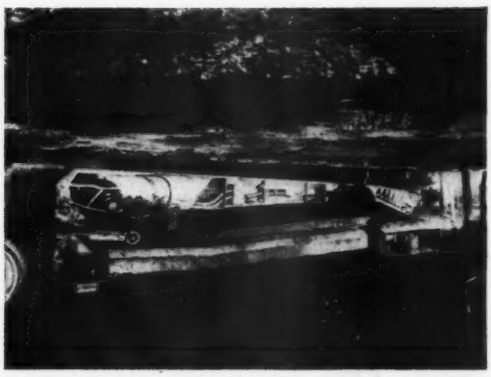
- **Multiple headings from one conveyor**
- **Recovery of pillars up to 100 feet wide**

The LONG "Full Dimension" Extensible Conveyor System offers higher capacity conveyor mining with all the flexibility of shuttle car haulage. Because of its long articulated reach and extensibility, this new system can be applied to almost any normal mining plan. The example on the opposite page is but one of many which can be used practicably.

Advantages of "FULL DIMENSION" MINING which have been demonstrated in many months of development and experimental use include:

- Continuous three-shift operation with virtually no delays for transportation.
- 67% increase in production per face man over a six-month period.
- Belt extensions are made, using the exclusive "HY-WINDER", at 60-foot intervals in approximately 15 minutes.
- Each extension (in 48" coal) permits the mining of 1500 tons with no delays except for repositioning the continuous mining machine.
- Deeper rooms and/or fewer belt moves with practical room transportation distance of 1000 feet or more.
- Dramatically improved housekeeping on the section with no constant movement of mobile machinery.
- Improved ventilation and safety because permanent stoppings are carried closer to the face with only the last open breakthrough being used for production haulage.
- Maximum crew cooperation resulting from the elimination of lifting, dragging, dodging, etc.
- Greater efficiency as there is more concentration of activity in a single working face for longer periods of time.
- Important safety advantages in improved roof support result from not having to keep open multiple haulways beyond the last open breakthrough.
- No wait whatsoever for transportation (except the 15 minutes required at each 1500 ton interval).

The "HY-WINDER" provides mechanical assistance in extending or retracting the belt conveyor. An extension requiring 15 minutes provides reach sufficient to mine over 1500 tons. (See diagram at left.)



The three-unit mobile bridge, an exclusive LONG development, is highly mobile and maneuverable. It provides articulated reach up to 150 feet during full continuous conveyor operation.

Write for details or a demonstration

The LONG Company
Oak Hill, W. Va.

V-R RED BITS

a BIT is only as good as its CARBIDE

29 years of carbide research and manufacturing experience . . . controlling quality from the ore to the finished product . . . have produced the faster cutting carbides used in V-R Red Bits.
Put these rugged bits to work in your mechanized mining equipment for continuous trouble-free production. Quality carbide . . . plus engineering knowledge . . . plus complete V-R service add up to better cutting performance.

The best mining bits are manufactured at V-R . . . beginning with the manufacture of the carbide.

Send for Catalog VR-488 for complete details.

V-R Vascoloy-Ramet corporation

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keeps trucks on the move

How can you be *sure* of high production? Consider this: *more quarry and mine operators depend on Bucyrus-Erie electric shovels than any other.* Performance on the job proves that they are more rugged, stay on the job longer, require less service and maintenance.

Behind this kind of performance is Bucyrus-Erie *Balanced Engineering* . . . engineering that makes sure that all components are soundly designed, soundly built. The voltage control system is an example. It delivers fast acceleration and deceleration the instant you need it . . . gives you high torque at low speeds, high speeds at low torque . . . and is designed to be *consistently dependable.*

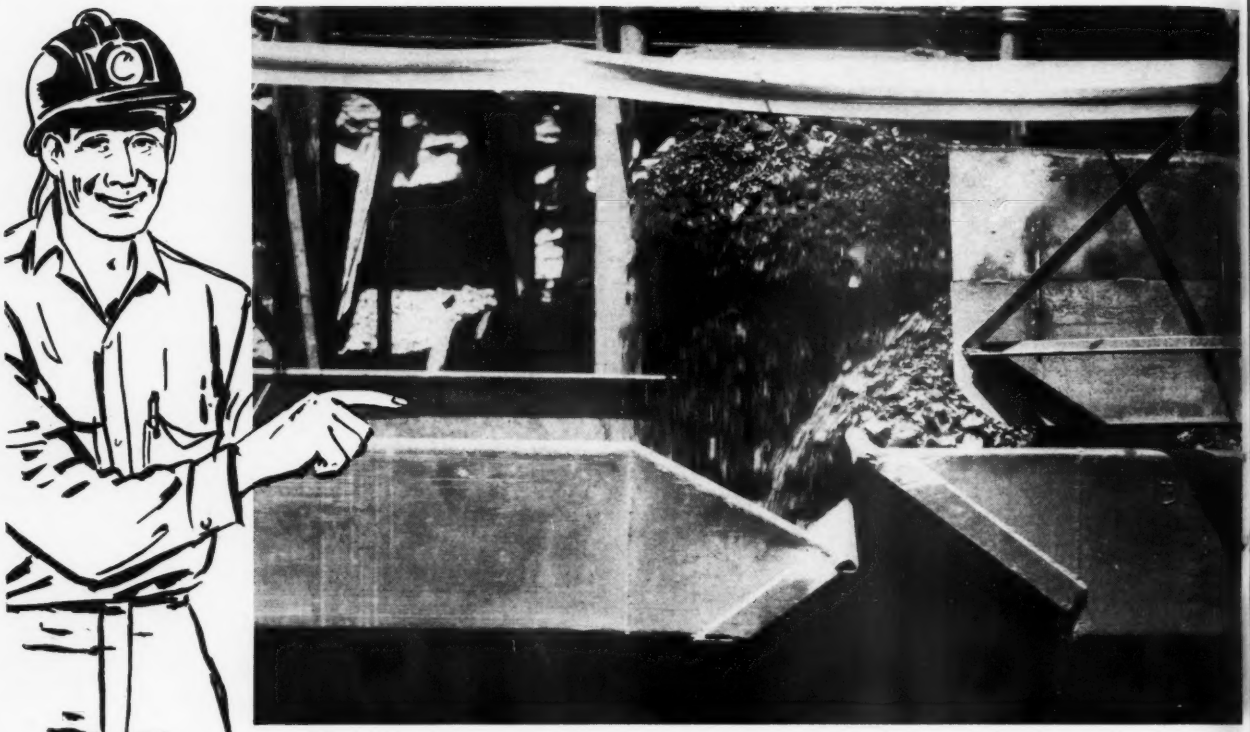
For the complete story on *Balanced Engineering,* write Bucyrus-Erie Company, South Milwaukee, Wisconsin, Dept. 2LD.

Bucyrus-Erie means . . .

Balanced Engineering

BUCYRUS ERIE®

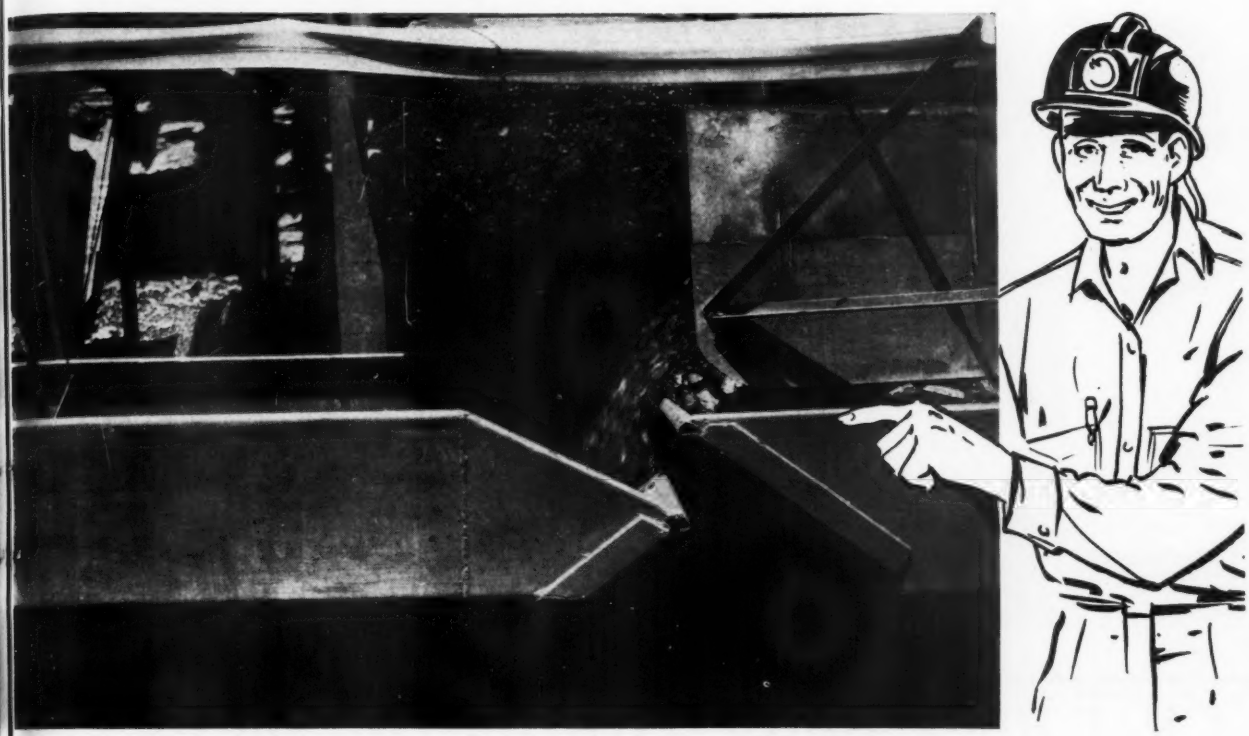
"Here, in unretouched pictures, why S-D Automatic 'Overlapping haulage cost to the



Note coal continues to flow from chute directly over exclusive S-D Automatic "Overlapping Ends" — without spillage between-cars. Photographer shot this picture while trip was in-movement.

This still-shot shows the Top Dresser Bar and Side Dresser Plate, which automatically dress the cars as they are automatically loaded!

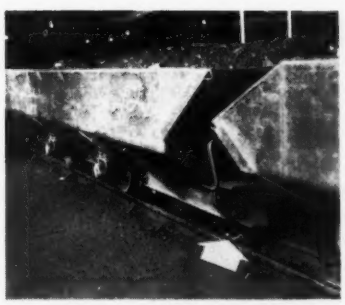
is shown one of the basic reasons End' Cars will reduce your absolute minimum..."



We had chute discontinue loading at the moment this picture was shot so you could see that in actual operation two things take place: (1) as mentioned, flow of coal continues uninterrupted and also (2) after dressing car to underground haulageway height, surplus coal is plowed into next car in trip—thanks to S-D "Overlaping Ends."

EVERY YEAR, without exception, more mines convert to the S-D Automatic Car Haulage System. What are the reasons?

1. Since the mining operation at the face and the preparation of coal for shipment are separate and distinct functions, operators want them to be carried on independently, so that each may operate in the most economcial manner . . . in other words, so that no interruption or slow down in one will interrupt or slow down the other. They want the system that will continuously remove coal from the loading point as it is mined, and, at the same time, will provide a continuous supply for the preparation plant. Automatic Bottom Dumping Mine Cars are the only known means of low cost coal mine transportation that will allow a continuous movement of coal from the face, or loading point, to the railroad car. Reason for this is because these cars are the only method of haulage that can use a low cost, low maintenance, large capacity SURGE BIN, which serves as a temporary storage for coal in transit and thereby balances the mining and preparation operations.



Automatic Dumping ON-THE-MOVE!

2. Lower initial capital cost — 40% fewer cars required . . . fewer locomotives . . . rotary dump requires special dump at high cost . . . cleaning plant may be of smaller capacity because it does not have to handle all the coal as quickly as it is mined.

3. Lower operation cost — fewer cars, fewer locomotives . . . no rotary dump to operate and maintain . . . no dumping labor, and with S-D "Overlapping End" Cars no loading labor!

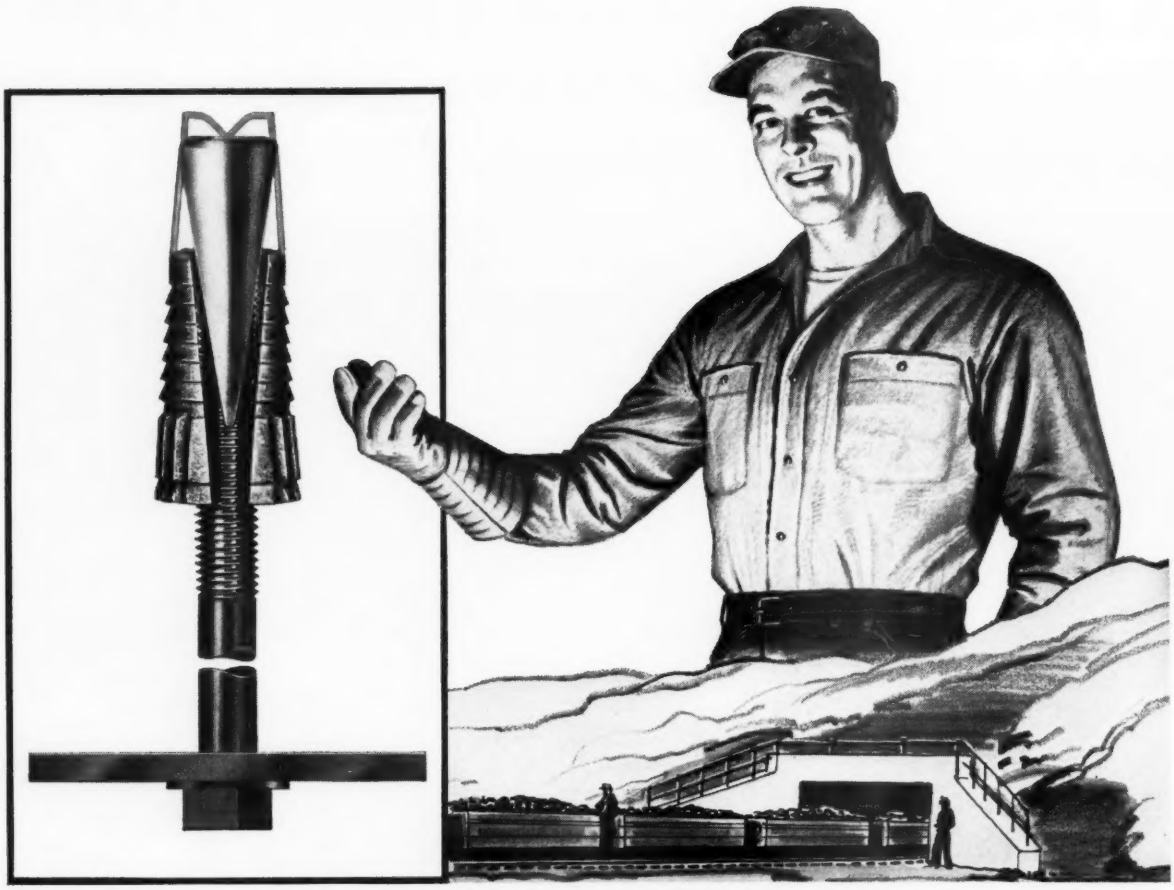
4. Greater flexibility — cars of any size and dimension can be dumped over same SURGE BIN, provided each has same track gauge, of course. Double tracks can be used over bin where desirable. No tilting chutes or other similar mechanisms required at loading points; therefore, less headroom and less capital cost, plus minimum time required for moving loading set-up! No other coal haulage system gives the flexibility provided by Automatic Bottom Dumping Car Transportation!

These are some of the fundamental reasons why the S-D Automatic Bottom Dumping Car Haulage System reduces cost to the absolute minimum. How much can you save? We recommend a fact-finding survey by our Application Field Engineer. No obligation, of course. May we get together? Write or call us today!

Sanford-Day Iron Works, Inc., Knoxville, Tenn.

SANFORD-DAY

KNOXVILLE, TENNESSEE



CF&I Rock Bolts with Pattin Shells give maximum anchorage

The Image of CF&I stands for a line of quality steel products that are prominent in the mining industry.

One of these—CF&I Expansion Rock Bolts with Pattin Shells—are widely used because of several exclusive design features. The double expansion of Pattin Shells gives parallel contact along the entire length of the hole, thus ensuring maximum anchorage in any type of rock. The Pattin design provides a maximum resistance to load with minimum displacement.

High strength steel—made to American Standard Specifications for roof bolting materials—provides an ample factor of safety. And CF&I Rock Bolts have been fully safety-tested, thoroughly proven in use.

Maximum utilization of available work space and ventilation facilities is possible with CF&I Rock Bolts, since cumbersome, space-consuming timbering methods are often unnecessary. When used with CF&I's Realock Metallic Fabric for lagging, CF&I Rock Bolts offer proved initial-cost savings up to 35% over timber set costs.

CF&I Rock Bolts with right hand threads are available in ¾″, ⅝″ and ⅞″ diameters, and in four different sizes of Pattin Shells. The ¾″ bolts are also made with left hand threads for tightening by drilling machines.

CF&I also makes a complete line of 1″ Wedge Type Rock Bolts, as well as ¾″ expansion type slusher pins.

OTHER CF&I STEEL PRODUCTS FOR THE MINING INDUSTRY

CF&I Grinding Balls • CF&I Grinding Rods • CF&I Mine Rail and Accessories • CF&I-Wickwire Rope • CF&I Industrial Screens • CF&I Grader Blades

A 20-minute Rock Bolting color movie "Make Mine Safety" is available for showing at no charge, through the CF&I office nearest you.

CF&I STEEL

MINING PRODUCTS

THE COLORADO FUEL AND IRON CORPORATION

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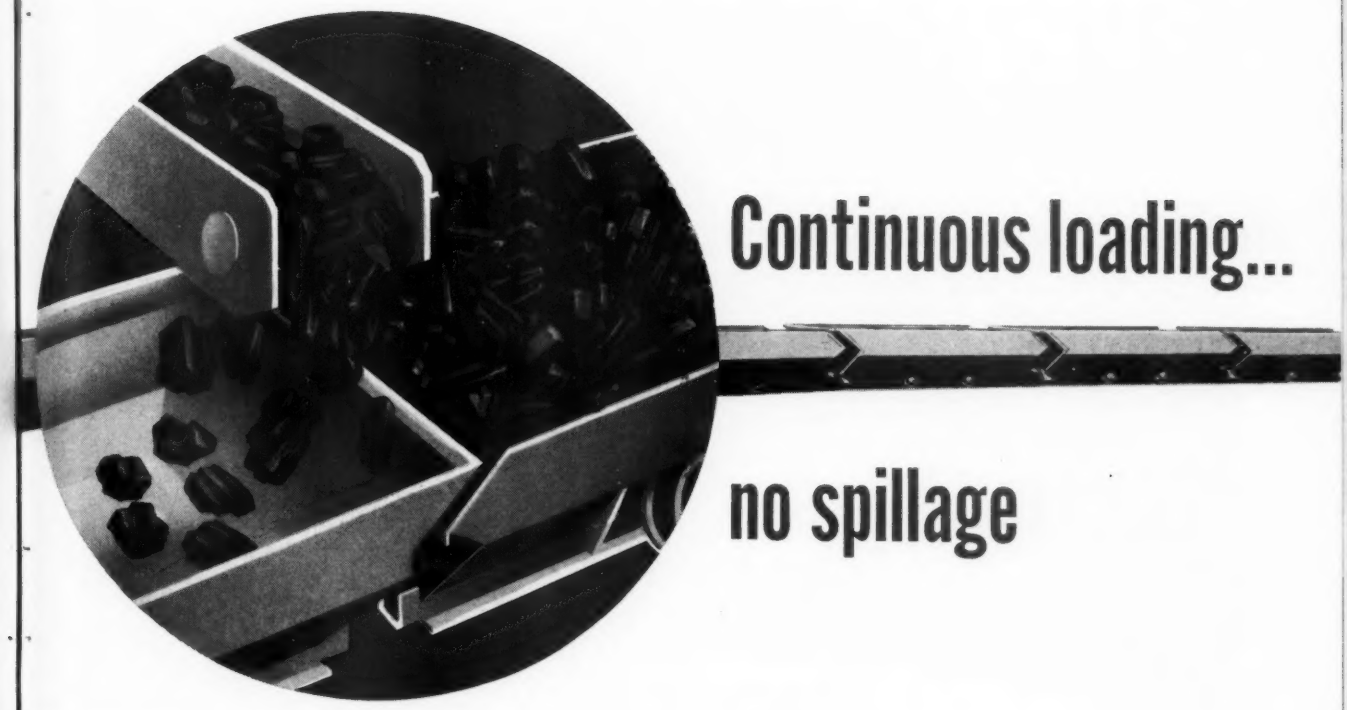
In the West: **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso • Farmington (N.M.) • Ft. Worth • Houston Kansas City • Lincoln • Los Angeles • Oakland • Oklahoma City • Phoenix • Portland • Pueblo • Salt Lake City • San Francisco • San Leandro • Seattle • Spokane • Wichita

In the East: **WICKWIRE SPENCER STEEL DIVISION**—Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia



Continuous loading...

no spillage

acf EXTENDED-END DROP-BOTTOM MINE CARS

Extended Ends on each car catch coal that would otherwise fall between cars: the entire trip is loaded faster, without stopping the trip or the flow of coal pouring from the loading mechanism. Spillage between cars is eliminated. Haulage safety is increased.

Other special features included only in acf drop-bottom mine cars:

- **all-welded end sill members.**
- **double-action spring bumpers that cannot tip, flatten or crush.**
- **lubricated doors for easy, positive action with faster unloading.**

Forty years of acf experience in mine car design and manufacture back up the acf Representative. He can give you full information on all sizes and types of mine car from 2 to 30 tons and larger. Why not discuss your haulage requirements with him? Just call your nearest acf Sales Office.

Bulletin describing all types of acf Mine Cars available on request.

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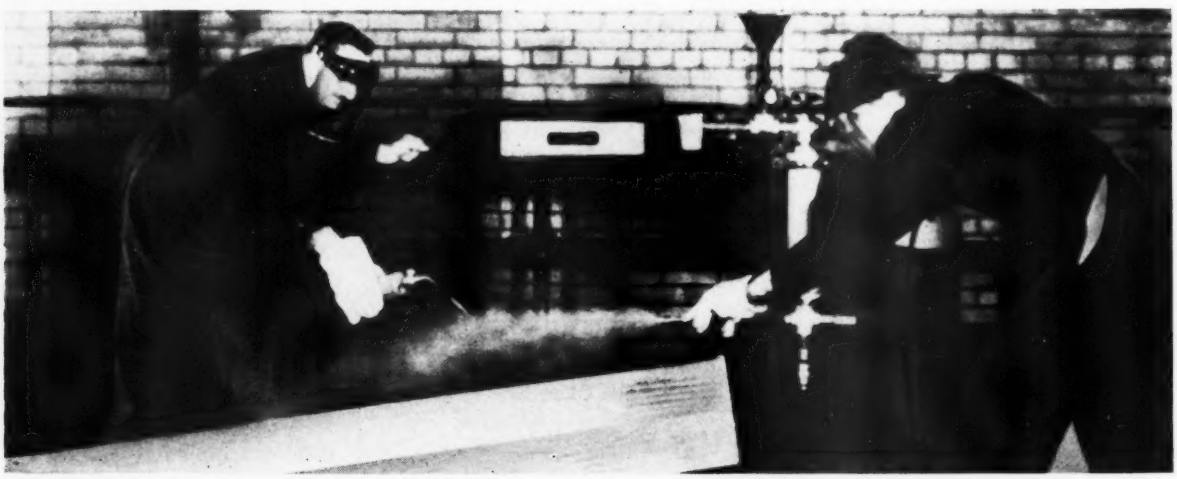
First low-cost

Flame tests prove fire-resistant properties of this hydraulic oil

Dramatic photo above shows flammability of conventional hydraulic oil.



Not so dramatic, but . . . see how Shell 3XF Mine Fluid resists flame.

Photos courtesy: U. S. Bureau of Mines

SHELL 3XF

fire-resistant mine fluid

Shell 3XF Mine Fluid has been tested by U. S. Bureau of Mines and is now in use

Now—for the first time in mining history—an inexpensive, fire-resistant emulsion-type hydraulic fluid is available for mine equipment use—Shell 3XF Mine Fluid.

NO MAJOR MODIFICATION OF EQUIPMENT IS NECESSARY—Shell 3XF* is a direct replacement for ordinary hydraulic oils now in service.

CONVENIENT TO USE—Shell 3XF Mine Fluid, furnished as a concentrate, is mixed with water to prepare the emulsion *at the mine location*.

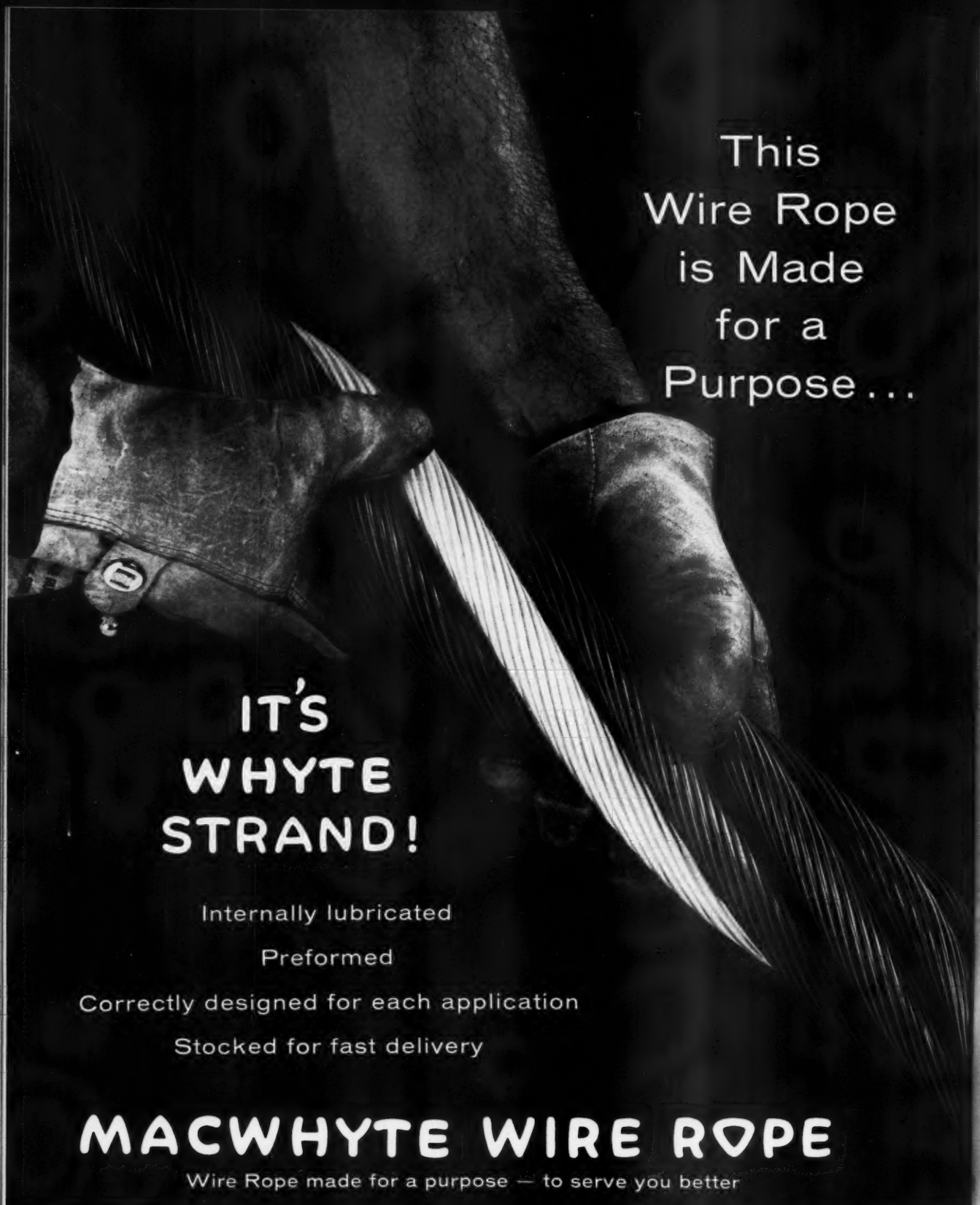
PROOF OF ITS FIRE-RESISTANT QUALITIES—In addition to recommending the use of fire-resistant hydraulic fluids in mining machinery, the Bureau of Mines has evaluated Shell 3XF Mine Fluid using test methods that determine fire-resistant properties, and accepted it for Mine evaluation, pending the establishment of a Bureau approval schedule.

FOR COMPLETE INFORMATION on Shell 3XF Mine Fluid, write or call Shell Oil Company, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California. In Canada: Shell Oil Company of Canada, Limited, 505 University Avenue, Toronto 2, Ontario.

*Trademark

MINE FLUID

SHELL



For strip shovels, loading shovels, draglines, shaft hoists, haulage, underground scrapers, loaders, mining machines, conveyors, car pullers, blast hole drills.

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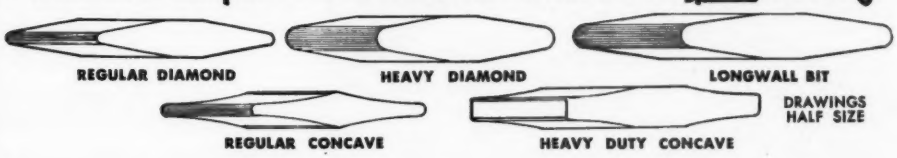
Manufacturers of a thousand and one different wire ropes, slings, and cable assemblies
Distributed and stocked throughout the United States

We can supply one single cutting bit... or a complete Ripper Head for continuous mining

When you want something special, Bowdil has the staff and facilities for economical designing and custom-building.

Our "throw-away" Bits are tempered & hardened to best suit your cutting.

There are **5 TYPES, 3 TEMPERS MEDIUM, TOUGH & HARD**



We make Cutter Bars for all machines, Chain for any bar, and Sprockets of every type, many available from stock

Also:

"No-Bend-'em" Spike Pullers

"Changeable-Points" Hand Picks

"No-Tools-Needed" Rope Sockets

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BOWDIL

ALWAYS *RIGHT* ON THE JOB

HAULS OF

HERE ARE on-the-job stories of five United States Rubber Conveyor Belts, taken from "U.S." belt records in the coal mining industry.

These belts are just some of the "U.S." standouts which demonstrate, year after year, why "U.S." is the world's largest producer of conveyor belts.

For steady, day-in and day-out dependability in conveyor belting, it always pays you to secure the advantages of "U.S." Engineering. "U.S." Engineers work directly with "U.S." Distributors or original equipment manufacturers to assure their obtaining the right belt recommendations for each type of conveying.

The most comprehensive belting engineering information in the industry is available through your "U.S." Distributor. It will pay you to check with him.

U. S. CONVEYOR BELTS

"A revolution in strip mining," says superintendent, "U.S. Conveyor Belt helps us save $1500 per week."

The Will Scarlet mine near Stonefort, Ill., has an outstandingly successful use of the first overland belt conveyor in a strip mine. The conveyor belt system, using a U. S. Giant® Belt, reduces the number of trucks, eliminates extra roads and high maintenance costs. The belt makes possible economical stockpiling for continuous operation: miners can continue working without a tipple operation—or the tipple can produce without a mining operation. The system can be moved to any location on the 3,000-acre tract. As the pit progresses overland, more lengths are simply added to the belt. "Maintenance costs are very low. Our savings are $1500 per week. We intend to install additional 'U. S.' Belting soon." *Another Three-Way Engineering Triumph.*

"After 20 years, 'U.S.' still gets the replacements," says plant foreman

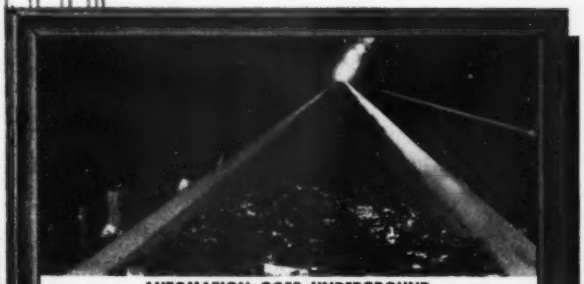
Mr. James Campbell of Guyan-Eagle Coal Co., Kelly, West Va., knows why Guyan-Eagle has been using (and replacing with) "U. S." belts in their 5 mines. In the words of the company's own officials, "U. S." Belts are:

"The most dependable in our experience."
"Resistant to abrasive action of rock."
"Strong, durable—maintenance is minimum."

FAME

40,000,000 tons of washed coal

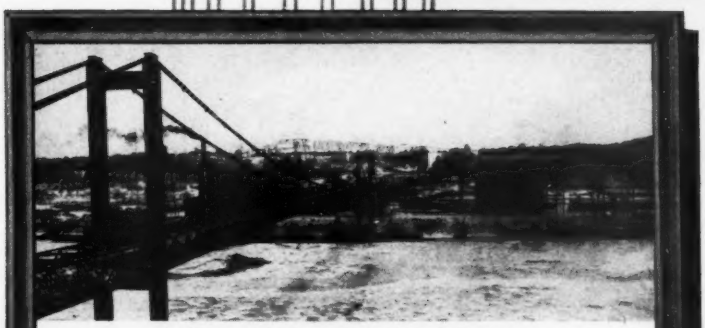
This is the minimum tonnage expected to be hauled in an estimated 12-year life by the main "U. S." belt. Installed in U. S. Steel's Robena Coal Mine, Uniontown, Pa. Robena is three mines, serviced by the same preparation plant. It is one of the largest coal-producing units in the nation. A single U. S. Rubber slope belt (installed 1953) conveys all the washed coal, amounting to over 20,000 tons a day. An earlier "U. S." Belt (installed in 1951) conveys coal to the blending bins.



AUTOMATION GOES UNDERGROUND

"U. S." Belts help make foolproof the push-button conveyor system in the Dana Slope Mine of Amherst Coal Co., (Rensford, West Va.).

Limited storage capacity, both inside the mine and on the surface, makes it mandatory that this slope conveyor operate without stoppage. So Amherst, knowing the "U. S." reputation for dependability and long life, selected a 42" U. S. Giant 6-ply YN belt. Operating since 1952, it has given completely trouble-free service.



Coal crosses the river on a belt 3870 feet long

Jones & Laughlin preparation plant at La Belle, Pa., is one of the world's largest. Here outputs from Vesta and Shannopin mines are combined.

Coal from the Vesta is carried across the river on a 3870-foot U. S. Rubber Conveyor Belt supported by the world's longest belt conveyor suspension bridge. This belt (actually all the belts in the system are "U.S.") has been operating since 1948 without a breakdown. In these eleven years it has carried a total of 44 million tons so far.

US RUBBER

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

In close quarters . . .

O-B SHELLS AND PLUGS

they've proved easier to work with!

Where space—and time—is at a premium, the requirement is an expansion unit that "goes up easy and stays put!" Here flexibility is critically important—the ability to compensate for and overcome slight variations in the size and shape of the bolt hole. Here fast-setting expansion is a must—the ability to expand fast and hold fast in soft friable shale as well as hard rock. Here four-way expansion, low unit stresses, maximum *effective* use of the anchor's strength mean faster, safer, more efficient bolting—and here more and more operators are now specifying O-B expansion shells and plugs!

OHIO BRASS COMPANY • MANSFIELD, OHIO
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Ohio Brass — HOLAN

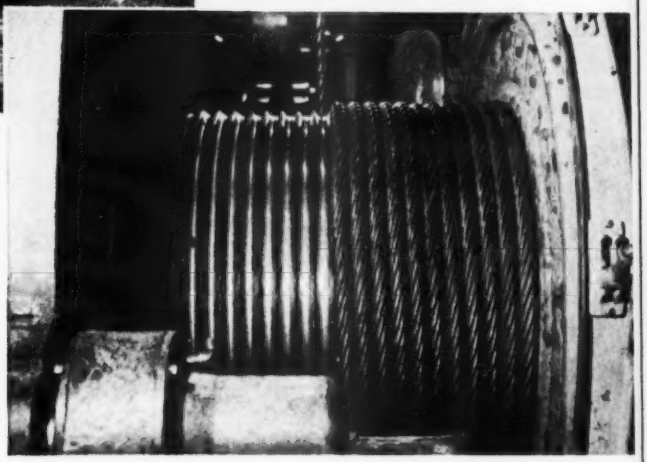
EXPANSION SHELLS AND PLUGS • LINE MATERIALS • SAFETY AND CONTROL EQUIPMENT • ELECTRIC HAULAGE MATERIALS

4941-M

2¾" **Tiger Brand** hoist ropes going through the boom point sheaves.

40-cubic-yard shovel stripping overburden at the Little Sister Mine of the Truax Traer Coal Company, St. David, Illinois.

Main hoist drum with well-lubricated Tiger Brand Rope in excellent condition after long service.



USS Tiger Brand— America's No.1 Wire Rope used on most big shovels

This 40-cubic-yard shovel, owned by the Truax Traer Coal Company, has been removing overburden at the Little Sister Mine near St. David, Illinois, for more than nine years. The hoist line is a 550-foot, 2⅜-inch diameter Tiger Brand Wire Rope, and the four boom supports are also Tiger Brand.

During this period, millions of cubic yards of rock and earth have been moved, and the Tiger Brand Wire Ropes have given long service life and dependable operation.

Since this 40-cubic-yard shovel went into service, we have seen the size of big shovels advance to 55, 60 and 70 cubic yards . . . and most of these big strippers are equipped with Tiger Brand Wire Rope.

Write now, for our latest booklet on wire rope. American Steel & Wire Division, Room 9124, 614 Superior Ave., N.W., Cleveland 13, Ohio.

USS and Tiger Brand are registered trademarks

Why Tiger Brand is your best buy

1. It is made by a company that maintains the most complete wire rope research and manufacturing facilities in the country.
2. It is designed by one of the country's most capable staffs of wire rope engineers. It is serviced by thoroughly experienced field representatives always ready with their assistance.
3. Every type of Tiger Brand Wire Rope is designed for specific applications. You get the *right* rope for the job.
4. It is made by one company, U.S. Steel, and every step of production, from ore to finished product, is carefully controlled and supervised to guarantee one high standard of quality.
5. Tiger Brand Wire Rope is manufactured by the largest single producer in the country.

USS American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad

Equipped with free-cutting Kennametal* U7J and J2 style bits, this Jeffrey Colmol loads a 2½-ton shuttle car in 30 to 40 seconds.

"Sure, bit costs are important . . . but it's tonnage that pays the bills"

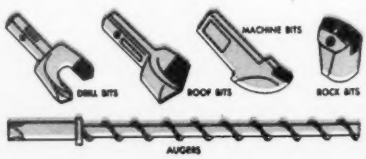
Bit-cost-per-ton is at a new low but this company† buys Kennametal Bits primarily because of the way they cut coal

In Indiana County, Pennsylvania, the Miller "B" Seam averages 42 inches, and is characterized by a sulfur streak in the middle. This streak varies anywhere from a feather to about two inches thick. While the roof is fairly good, frequent bottom rolls of hard fire clay extend from 4 to 22 inches up into the bed. Under these conditions, the company had difficulty finding a long-lasting bit that would satisfactorily cut this seam. Not only did the machine have a slow rate of advance, but the heavy strain on the cutter heads resulted in an excessive power load. Then the company tried Kennametal Bits and not only obtained good production but relieved the excessive strain on the machine.

Ask your Kennametal Representative how Kennametal cutter bits and drill bits can improve *your* production. Let him help you select and actually test in your mine the Kennametal Bit designed to match your operating conditions. Call your Kennametal Representative or write KENNAMETAL INC., Mining Tool Division, Bedford, Pennsylvania. 5703

*Trademark †Clymer No. 2 Mine, Morrisdale Mining Company

INDUSTRY AND
KENNAMETAL
...Partners in Progress



EDITORIALS

ROBERT W. VAN EVERA, Editor

JUNE 1959

The Stop Watch and Coal Mining

Just a few years ago the coal industry began to re-examine the virtues of an industrial engineering approach to mining problems. In many cases it was done with reluctance because of the poor experience with the same subject, first during the 1920's and later in the 1930's.

But by the 1950's the time was ripe (coal mining had developed into a highly mechanized business and industrial engineering methods had been improved) for this important tool of modern management to be put to effective use by the industry. For, since the first few attempts to measure performance at the face there has risen a whole new generation of coal miners who are able, not only to measure past performance but to set future performance standards, taking into full account the vast array of variables that are inherent in mining.

This generation, using the term "standard measurement" as its theme has advanced into the area of cost control and is now producing some of the most noteworthy developments in coal mining. With their stop watches and electronic computers they are reducing to hours and minutes the work that used to take months and days in pinpointing specific causes for mining costs that are out of line. They stand on the threshold of a whole new era in mine management and are symbolic of a transition that, while it has not received the publicity which has been given the trend to continuous mining, is just as important.

Its Pittsburgh in 1960

Now that the curtain has been rung down on the 1959 AMC Coal Show—and a most successful Show it was—plans are going ahead for the 1960 Coal Convention of the American Mining Congress. Planned for Pittsburgh, Pennsylvania, May 9–11, the "paper" convention will again bring industry leaders together to discuss advances in all phases of coal mining technology.

The scheduling of the 1960 Coal Convention in Pittsburgh breaks a modern tradition which has seen the "off year" meetings held in Cincinnati. However, Pittsburgh has much to offer as the location for the 1960 meeting. Not only is the Gateway City the hub of our country's coal mining industry, but it is the center of a large mining area and is readily accessible by airline, railroad and automobile.

Pittsburgh is justly proud of the redevelopment of its downtown area and with the construction of a new hotel, to be completed this fall, the city is waiting to receive next year's Coal Convention with "open arms."

The State of Russian Mineral Production

With all the claims and counter-claims by Iron Curtain and Free World economists as to the economic growth of the USSR it is difficult to separate fact from propaganda. There can be no doubt that Russia has made great strides in developing her economy—particularly her natural resources. Just how great this growth has been is subject to conjecture.

We came across a couple of statements, though, in a recent publication of the National Association of Manufacturers, "A Glance at the Russian Economy," that touch on subjects that mining engineers understand. One statement is that "the planned amortization period for fixed capital in copper mining is 86 years." The other is, "some Siberian iron mines are producing ores which contain only 20 percent iron." If these statements are factual and are representative of the mineral extraction industry in Russia, can the continued growth of that industry be assured? Using the experience of the Free World it would seem that it couldn't.

FUTURE ASPECTS of MINE VENTILATION

By

RAYMOND MANCHA
Vice President—retired
Joy Manufacturing Co.

As mine workings are driven deeper, ventilation will become more difficult. Greater distances for air transport and higher rock temperatures will place a greater dependence upon refrigeration and recirculation of the air reaching the working places. The outstanding advance in mine ventilation, however, will be a stricter observance of the many established basic principles that have been neglected during periods of easy-to-get ore when almost any type of ventilation seemed to suffice

Pictures provided by Homestake Mining Co. of Lead, S. D.

AS depletion of remaining ore deposits proceeds, mine ventilation will become increasingly difficult and will require closer adherence to basic mine ventilation axioms which, in the past, have received only half-hearted acceptance by the mining industry.

Mining areas will become less accessible because depths will become greater, and rock temperatures correspondingly higher according to the local temperature gradients.

The wisdom of providing air-shafts of greater capacity will become more apparent than in past eras of readily accessible ore deposits. An air-shaft should be of sufficient cross-sectional area to limit shaft air-speeds to approximately 1100 feet per minute for unlined or timbered air-shafts and 2200 feet per minute for smooth lined air-shafts.

Less dependence, than formerly, should be placed upon stopes and raises for entrance or egress of air to or from the mine. Such practice is more unstable and unpredictable than the provision of intelligently planned air-shafts.

Desirable Goals Outlined

In view of the initial cost and maintenance costs of air-shafts, it obviously is desirable to restrict the load imposed upon the air-shafts within limits of sound practice. One method of accomplishing this objective is to recirculate the air reaching the working areas as much as possible. This requires filtering the air leaving dust-generating zones, for

which, air filtering equipment has recently been made available of greatly improved design from the standpoints of compactness and both power and water requirements.

In recent years, as a by-product of the stepped-up activity in aerodynamic research and development, especially in the acquisition of reliable cascade airfoil data here and abroad, it has become possible to build mine fans and blowers (both axial and centrifugal) of greatly improved design, considering compactness, low speed, pressure developing potential, etc. In order for the mining industry to fully realize the advantages of this improved know-how, sufficient pressure must be applied in the right place to the equipment manufacturers to inspire allocation of the necessary funds for research and development.

It is to be expected that air-cooling will play an increasingly important role in future mining operations. By air-cooling is meant the practice of delivering artificially refrigerated air to the working areas underground. This refrigeration is usually best accomplished by the use of surface regenerative type cooling towers or surface or underground located refrigeration machines, working either singly or in combination. The importance of controlling the wet-bulb temperature of the mine air reaching the miners becomes particularly apparent when mining in hot-rock areas. The production per man is the most critical barometer.

When ventilating dead-end rock tunnels, effective smoke scavenging is best accomplished by exhausting sufficient air to maintain a tunnel air speed of approximately 50 feet per minute. In still air, smoke or nitrous fumes diffuse at a speed of 28 to 30 feet per minute. Above this critical speed the smoke or fumes are moved as a body whereas below the critical speed the smoke is gradually diluted but never removed. Alert mine management is becoming increasingly alerted to the importance of effective smoke removal methods in dead-end tunnel driving which should be reflected in increased output per man.

In modern mining, dust detection and control is receiving more and more attention. The problem is being rightfully placed in the hands of qualified personnel backed up by properly instrumented laboratories and modern test techniques. This is money well spent and represents an additional link in the safety chain that will delay and possibly circumvent the day of Federal Safety supervision for metal mines.

Although continually improved equipment is, and will become available to the mining industry for bettering mine ventilation, it is this observer's considered opinion that enlightened management and supervisory personnel are becoming more cognizant of the increasing difficulties of maintaining proper mine ventilation with increasing depletion and, therefore, future mine ventilation will be most characterized by closer adherence to tried and true principles of long standing.

Example of Well Ventilated Mine Given

An example of a well ventilated mine employing sub-level caving extraction would be as follows:

Locate an adequately proportioned air-shaft in the footwall connecting will all haulage levels; this air-shaft to be in addition to the hoisting shafts and to serve as either an intake or return air-shaft depending upon climate and other local factors. This air-shaft will work in conjunction with available stopes and raises as long as practical, following which an additional air-shaft located in the hanging-wall may be required to supplement the stopes and raises.

On each haulage level a primary mine fan should be installed thereby leaving the surface clear for heating elements, if required, and greatly eliminating the need for primary air regulation on each haulage level, thus saving power.

Practically complete elimination of primary regulation on the haulage levels can be accomplished by either

(*Continued on page 43*)

Alert mining companies will adhere more closely to long standing basic mine ventilation axioms. Experience has shown that getting the air where it is needed, in the proper quantity, velocity and temperature pays off in increased output per man, better health conditions, and greater safety

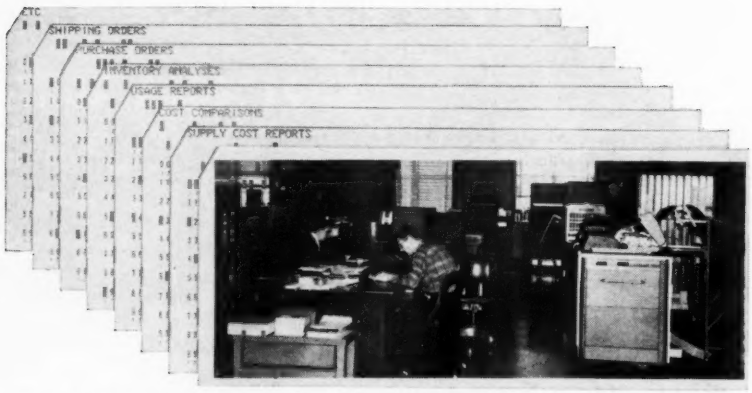


Fig. 1. All of Pocahontas Fuel Company's supply reports could be prepared manually but the cost would be much higher and the increased time lag would result in a loss of effectiveness. For these reasons, IBM machines are included in the organization of the supply system. They can process tremendous quantities of data and produce the desired reports in a relatively short time

SUPPLY COST REDUCTION by IBM Methods

Pocahontas Fuel Company's detailed supply cost reports have provided management with a foundation upon which it is building a cost-reduction program. Costs can be analyzed from the total right down to individual items regardless of classification. Not only do these reports make fixing of cost responsibility possible but they disclose where action is necessary to stay within objectives

By

E. P. BUCKLEN
Special Engineer
Pocahontas Fuel Co.

IN an era of increasing competition and rising costs, mining companies have been forced to utilize more and more modern mining and preparation equipment. To maintain a favorable competitive position, productive equipment must be kept in sustained operation. Thus, of economic necessity, supply systems must be maintained which will provide adequate quantities of machine parts and other supplies for effective operation. Because of increased inventories, higher prices, rapid turnover, and in some cases poor quality and utilization; such supply systems are fertile fields in which to sow cost-reduction efforts.

Pocahontas Fuel Co., a division of Consolidation Coal Co., has made, and is in a position to make further worthwhile savings in the cost of its supply system. This system includes a purchasing organization functioning through a central warehouse and individual collieries.

Such a supply system is in a constant state of change. All these changes must be considered if substantial savings are to be realized without adverse effects on producing ability. To accomplish this, all personnel engaged in the cost-reduction effort must be provided with periodic reports. These reports must show pertinent details of the status and functioning of the system.

Within the Pocahontas Fuel supply system many different regular reports are prepared for various management and supervisory personnel. In addition, special reports and analyses have been made when needed. Some of the company's regular reports will be discussed in this article.

Why IBM Machines are Used

All of Pocahontas Fuel's supply reports could be prepared manually, but the cost would be much higher and the increased time lag would result in a loss of effectiveness. For these reasons, IBM machines are included in the organization of the supply system. The machines can process tremendous quantities of data and produce the desired reports in a relatively short time. While the subject of this article is the application of IBM machines to supply cost reduction, original justification for the machines was for payroll, sales analysis and accounting purposes. The extra savings on supply, engineering, and statistical work are being realized at only a slight additional cost over original expenses.

Types of IBM Machines

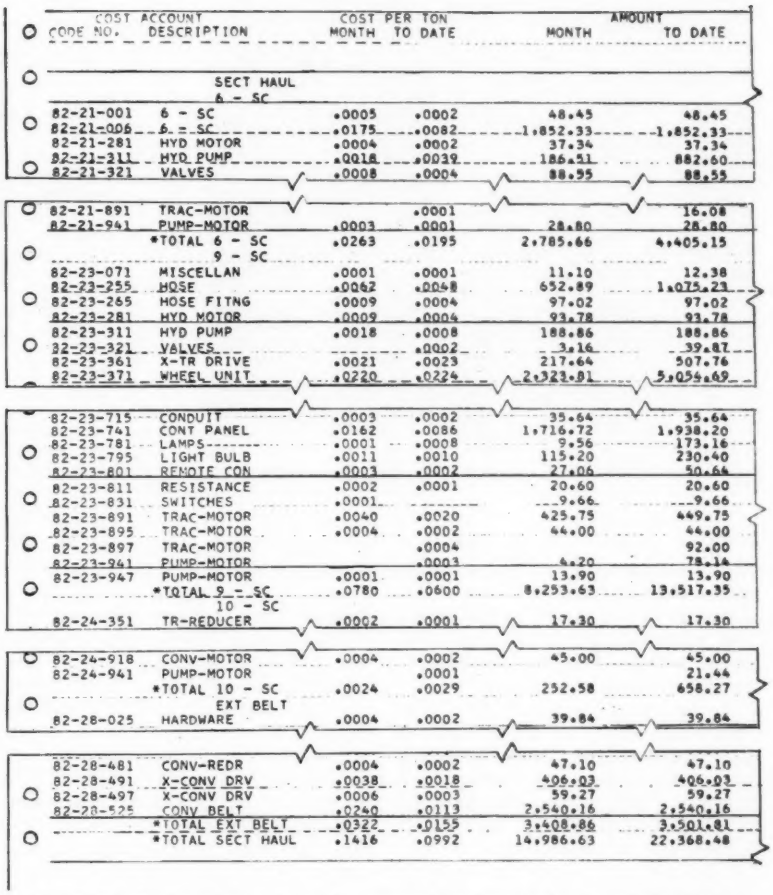
Many types of automatic office machines are made by IBM and other manufacturers. The machines to be described in this article are standard equipment made by IBM and are all used by Pocahontas Fuel. As a group they constitute an integrated data processing system.

These machines are characterized by remarkable operating speeds and flexibility. They are generally kept in sustained operation by electrical impulses passing through holes punched in cards—punched paper tapes and magnetic tapes are used at times. They are basically integrated systems of complex electro-mechanical, intricate mechanical, and in some cases, electronic and/or magnetic components. Optional features are available to fit the requirements of individual users. All of the foregoing statements are descriptive of each of the machines to be described below.

Keypunch Machine. Keypunch machines are the means of transferring written data to cards for processing on other machines. Data on the cards are in machine language—i.e. punched holes. The location and number of holes in a vertical column determines the meaning. Cards are punched by electro-magnetically operated punches. These punches are coupled to a manually operated typewriter keyboard. The keypunch can be programmed to duplicate, skip, or stop for manual punching in any card column or group of card columns. Cards can be punched automatically from a punched paper tape when a tape reading attachment is added. The number of cards which can be punched in a given time varies with the proficiency of the operator and the number of card columns per card to be punched. For example, if 20 columns per card are punched, the output per machine would be about 600 cards per hour.

Verifier. To minimize human errors in data transfer, cards from the keypunch machine are proved by another operator on a verifier. The verifier looks and operates practically the same as the keypunch. The data in a card is correct when impulses through the card equal impulses from the keyboard. If a card is correct the upper-right edge is notched. If the card is *incorrect* (unequal impulses), the upper-right edge is *not* notched. However, a notch is made over the card column in which an error occurs, after the third indication that an error exists. As can be seen, the only possibility for an error passing undetected is for two people to make the same error.

Sorter. The sorter is designed to arrange cards in numerical or alphabetical sequence. It operates on a single card column at a time, but does it at the rate of 1000 cards per minute. Thus, to arrange 1000 cards containing five-digit part numbers in numerical order would require five minutes and five passes through the sorter. On each pass, cards are dropped into one of 13 pockets. Which pocket is determined by the position of the hole in the card and of the sort selection switch. These two conditions are used in selecting and excluding cards in sorting by setting additional switches. A special attachment makes card counting possible with or without sorting. Another feature makes card editing possible.



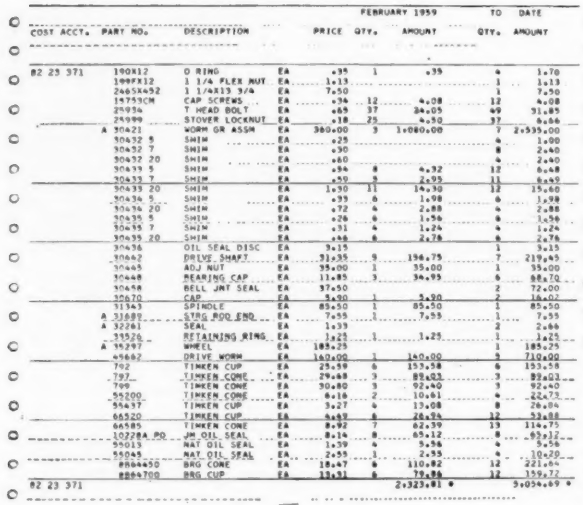
COST ACCOUNT CODE NO.	DESCRIPTION	COST PER TON MONTH	COST PER TON TO DATE	AMOUNT MONTH	AMOUNT TO DATE
	SECT HAUL 6 - SC				
82-21-001	6 - SC	.0005	.0002	48.45	48.45
82-21-006	6 - SC	.0175	.0082	1,852.33	1,852.33
82-21-281	HYD MOTOR	.0004	.0002	37.34	37.34
82-21-311	HYD PUMP	.0018	.0039	186.51	882.60
82-21-321	VALVES	.0008	.0004	88.95	88.55
82-21-891	TRAC-MOTOR		.0001		16.08
82-21-941	PUMP-MOTOR	.0003	.0001	28.80	28.80
	*TOTAL 6 - SC	.0263	.0195	2,785.66	4,405.15
	9 - SC				
82-23-071	MISCELLAN	.0001	.0001	11.10	12.38
82-23-255	HOSE	.0062	.0048	652.89	1,075.23
82-23-265	HOSE FITNG	.0009	.0004	97.02	97.02
82-23-281	HYD MOTOR	.0009	.0004	93.78	93.78
82-23-311	HYD PUMP	.0018	.0008	188.86	188.86
82-23-321	VALVES		.0002	3.16	39.87
82-23-361	X-TR DRIVE	.0021	.0023	217.64	507.76
82-23-371	WHEEL UNIT	.0220	.0224	2,323.81	5,054.69
82-23-715	CONDUIT	.0003	.0002	35.64	35.64
82-23-741	CONT PANEL	.0162	.0086	1,716.72	1,938.20
82-23-781	LAMPS	.0001	.0008	9.56	173.16
82-23-795	LIGHT BULB	.0011	.0010	115.20	230.40
82-23-801	REMOTE CON	.0003	.0002	27.06	50.64
82-23-811	RESISTANCE	.0002	.0001	20.60	20.60
82-23-831	SWITCHES	.0001		9.66	9.66
82-23-891	TRAC-MOTOR	.0040	.0020	425.75	449.75
82-23-895	TRAC-MOTOR	.0004	.0002	44.00	44.00
82-23-897	TRAC-MOTOR		.0004		92.00
82-23-941	PUMP-MOTOR		.0003	4.20	78.14
82-23-947	PUMP-MOTOR	.0001	.0001	13.90	13.90
	*TOTAL 9 - SC	.0780	.0600	8,253.63	13,517.35
	10 - SC				
82-24-351	TR-REDUCER	.0002	.0001	17.30	17.30
82-24-918	CONV-MOTOR	.0004	.0002	45.00	45.00
82-24-941	PUMP-MOTOR		.0001		21.44
	*TOTAL 10 - SC	.0024	.0029	252.58	658.27
	EXT BELT				
82-28-025	HARDWARE	.0004	.0002	39.84	39.84
82-28-481	CONV-REDR	.0004	.0002	47.10	47.10
82-28-491	X-CONV DRV	.0038	.0018	406.03	406.03
82-28-497	X-CONV DRV	.0006	.0003	59.27	59.27
82-28-525	CONV BELT	.0240	.0113	2,540.16	2,540.16
	*TOTAL EXT BELT	.0322	.0155	3,408.86	3,501.81
	*TOTAL SECT HAUL	.1416	.0992	14,986.63	22,368.48

Fig. 2. Supply cost report covering the company's "section haulage equipment." With this type of report, supply costs can be analyzed from the final total down through sub-totals and into specific items

Collator. This machine is also used for arranging and selecting cards. It can simultaneously compare 16 columns in two separate cards. The two cards can be part of the same stack or one from each of two stacks. Action can be based on the contents of a card being greater, equal, or less than that of two other cards. Thus, simultaneous consideration of the contents of a maximum of three cards is possible. The collator performs four general operations. These are: (1) selecting, (2) sequence checking, (3) merging and (4) matching. Various combinations of these operations gives this machine great flexibility. Maximum output is 480 cards per minute. This is the combined rate of 240 cards per minute from each of the two card feeds. Cards are dropped into one of four pockets as determined by control panel wiring.

Reproducer. It can duplicate the data contained in a card into a blank card. The reproduction can be in the same or a re-arranged form. At the same time the machine can also add to or eliminate portions of the original data. Thus, much keypunch work (the slowest in the system) can be eliminated. This machine can sense electrographic pencil marks on a card and punch the card as determined by the location of the marks and control panel wiring. This machine can be coupled to an accounting machine for summary punching also.

Accounting Machines. These machines are line-at-a-time printers.



COST ACCT.	PART NO.	DESCRIPTION		PRICE	FEBRUARY 1959 QTY.	AMOUNT	TO DATE QTY.	TO DATE AMOUNT
82 23 371	190X12	O RING	EA	.35	1	.35	4	1.70
	190FX12	1 1/4 FLEX NUT	EA	1.13			1	1.13
	2465X492	1 1/4X13 3/4	EA	7.50			1	7.50
	19793CM	CAP SCREWS	EA	.34	12	4.08	12	4.08
	25934	T HEAD BOLT	EA	.65	37	24.05	49	31.85
	24999	STOVER LOCKNUT	EA	.18	25	4.50	37	6.66
A	30421	WORM GR ASSM	EA	380.00	3	1,080.00	7	2,535.00
	30432 5	SHIM	EA	.25			4	1.00
	30432 7	SHIM	EA	.30			8	2.40
	30432 20	SHIM	EA	.60			4	2.40
	30433 5	SHIM	EA	.94	8	4.32	12	6.48
	30433 7	SHIM	EA	.50	5	2.95	11	6.49
	30435 20	SHIM	EA	1.30	11	14.30	12	15.60
	30436 5	SHIM	EA	.39	6	1.98	6	1.98
	30436 20	SHIM	EA	.72	4	2.88	4	2.88
	30435 5	SHIM	EA	.26	6	1.56	6	1.56
	30435 7	SHIM	EA	.31	4	1.24	4	1.24
	30435 20	SHIM	EA	.98	6	2.78	6	2.78
	30436	OIL SEAL DISC	EA	9.15			1	9.15
	30462	DRIVE SHAFT	EA	31.35	9	196.75	7	219.45
	30465	ADJ NUT	EA	35.00	1	35.00	1	35.00
	30468	BEARING CAP	EA	11.85	3	34.95	6	68.70
	30458	BELL JNT SEAL	EA	37.50			2	72.00
	30670	CAP	EA	5.50	1	5.50	2	10.402
	31343	SPINDLE	EA	85.50	1	85.50	1	85.50
A	31689	STRG ROD END	EA	7.55	1	7.55	1	7.55
A	32261	SEAL	EA	1.39			2	2.66
	31526	RETAINING RING	EA	1.25	1	1.25	1	1.25
A	35297	WHEEL	EA	185.25			1	185.25
	49662	DRIVE WORM	EA	140.00	1	140.00	5	710.00
	792	TIMKEN CUP	EA	25.59	6	153.58	6	153.58
	797	TIMKEN CONE	EA	29.68	3	89.03	3	89.03
	799	TIMKEN CONE	EA	30.80	3	92.40	3	92.40
	59200	TIMKEN CONE	EA	5.16	2	10.61	4	22.72
	59437	TIMKEN CUP	EA	3.27	4	13.08	8	26.04
	66520	TIMKEN CUP	EA	4.69	8	26.24	12	53.88
	66585	TIMKEN CONE	EA	8.92	7	62.39	13	114.75
	10278A PD	JM OIL SEAL	EA	8.14	8	65.12	8	82.12
	59013	NAT OIL SEAL	EA	1.39	4	5.56	4	5.56
	55045	NAT OIL SEAL	EA	2.55	1	2.55	4	10.20
	89064450	BRG CONE	EA	18.47	6	110.82	12	221.64
	89064700	BRG CUP	EA	13.31	6	79.86	12	159.72
82 23 371						2,323.91 *		5,054.69 *

COST ACCT.	PART NO.	DESCRIPTION		PRICE	FEBRUARY 1959 QTY.	AMOUNT	TO DATE QTY.	TO DATE AMOUNT
82 23 741	FROM C SHOP	JAN 28 1959				1,187.50		1,187.50
	1685	1/4 ZOSTOP NUT	EA	.05			12	.60
	EP 46 4	MERCURY SWITCH	EA	15.95	5	41.85	5	41.85
	EP 46 5	MERCURY SWITCH	EA	23.95			1	23.95
	EP 46 6	MERCURY SWITCH	EA	23.96	1	23.96	1	23.96
	EP 58 12	12 SMBD WIRE	FT	.12			190	22.80
	6810 10	STUD	EA	.27			4	1.08
	8257A	INSPECT COVER	EA	16.69	1	16.69	1	16.69
	19769	CONTACT TIP	EA	9.85	25	98.25	50	101.50
	19581	CONT SUPPORT	EA	.76	12	9.12	12	9.12
	19564	MOVING CONTACT	EA	.98	25	7.90	25	7.90
	19673	SPRING	EA	.08	12	.96	12	.96
A	19680	BRACKET	EA	.83	12	7.98	12	7.98
	19684	ARMATURE STOP	EA	.67	6	3.42	6	3.42
A	19698 1	ANC CHUTE ASSY	EA	8.10	3	24.33	8	65.82
	19700	TOP INSULATOR	EA	.49	6	2.94	12	5.94
	19701	BOTT INSULATOR	EA	.49	6	2.94	12	5.94
A	19720	ARMATURE ASSY	EA	7.90	5	39.39	6	43.76
RA	22209 1	JUNC BOX ASSY	EA	23.58			2	47.16
A	22926	SWITCH	EA	9.67			1	9.67
A	22987 18	CONTACTOR	EA	42.70	1	42.70	1	42.70
	23720 3	SOCK CAP SCREW	EA	.09	80	6.90	80	6.90
A	26108	SHUNT	EA	1.40	6	8.40	6	8.40
	26309	MOVING CONTACT	EA	.77	25	19.25	50	41.00
	26314	STA CONT TIP	EA	.31			25	7.75
A	29049 2	STA CONT ASSY	EA	15.95	5	79.75	5	79.75
A	31689	STRG ROD END	EA	7.55			1	7.55
A	40537	OPER COIL	EA	9.26	6	55.56	8	74.08
A	930100	RELAY MTG	EA	62.35	1	62.35	1	62.35
82 23 741						1,718.72 *		1,938.20 *

Fig. 3. (left) A portion of the supply cost report supplement. In this report the cost of a machine sub-assembly is broken down into costs of individual parts. Fig. 4. (right) A portion of the cost supplement covering the control panel. Notice that an A31689 steering rod end and an RA22205-1 junction box assembly are included in the list of control panel parts. This happened because of a coding error made during the first month the revised code was used and is pointed out as something to be guarded against

They can process data which requires addition, subtraction or simple multiplication. They can print the results with other selected data read from cards or emitted by the machine itself. The speed of operation varies with the type of machine. The IBM "407" will read up to 150 cards a minute and print a report on a predetermined layout. As many as 120 alphabetic, numeric and special characters can be printed to the line at the rate of 150 lines per minute. Carbon paper can be used for multiple copy reports to save machine time.

Computers. These electronic brains are the work horses in any equipment group. There are several types of computers used for business and scientific purposes. The IBM "650" is a type commonly used by business establishments. The "650" will do 78,000 additions or subtractions per minute; 5000 ten-by-ten multiplications per minute, and 3700 divisions per minute. The input-output rates vary with the type of input-output unit, the complexity of the problem, and the skill and knowledge of the programmer. For instance, with a "537 Input-Output Unit," a maximum rate of 155 cards per minute is possible.

The machines which have been described are the basic types that might be found in any integrated data processing system. However, there are many more on the market and details on each are available from the respective manufacturers.

Types of Supply Reports

Reference has already been made to the number of reports made within the Pocahontas Fuel supply system. The types and the functions of these reports will now be discussed.

Supply Cost Report. This report is unique in that it is so detailed. With this report, supply costs can be analyzed from the final total down through sub-totals and into specific items. The report shows the cost per ton of coal, the dollar amounts, and quantities for specific accounts. This is done for the month and the year-to-date on the same line. Every colliery is covered individually once a month and compositely at least once a year. Figure 2 is an example of what a portion of one of these reports might look like.

Before these reports could be prepared on IBM machines, much planning had to be done. Such things as what the report was to show; what data were required; how data could be accumulated; how the report was to be arranged; and machine programming, wiring and checking had to be satisfactorily resolved. With all this settled, the machines will do the reports indefinitely without need for further planning.

Determining how to accumulate data required much preliminary work. A standard coding system had to be developed which would allow adequate descriptions of the various supply transactions. This was necessary so costs could be accumulated on specific items and developed into general group totals. Another consideration was to facilitate machine processing of data. The development of this code also required training of various personnel in its use.

The supply cost code as originally developed consisted of five digits. It was used for one year and provided the foundation for an improved coding system. In the improved code seven digits are used. The new code has made it possible to produce a cost report with expanded coverage, more accuracy, greater detail and a lower cost per report.

This code is in three parts. Numbers from each part must be selected and combined to describe a transaction.

The first part consists of four-digit account numbers. These account numbers are of a specific nature and are grouped with other similar account numbers. In addition, each group has two group account numbers—one for a heading and the other for a total. At the present time the company has 332 individual account numbers and can expand to about 800 if necessary.

First digit in the account numbers never change. Its sole purpose is to integrate the supply cost code into a broad over-all accounting code. Doing this has eliminated some duplication of work. That is, the company now uses supply cost cards to do additional jobs which they could not be used for before.

Second digit places the cost into one of several general classifications. These classifications are mine operating, mine maintenance, tipple operating, tipple maintenance, outside opatering, and maintenance, and special work supplies.

Third and fourth digits are specific and group account numbers within the general classifications. Ventilation and brattice cloth are examples of group and specific account numbers under the mine operating supply classification. Under mine maintenance, loading machines and 14-BU

loader are examples of group and specific account numbers. All general classifications are similarly divided and sub-divided so that all equipment types and operating supplies have specific account numbers within common groups.

The second part of the code consists of two-digit sub-account numbers and was designed primarily to allow costs to be accumulated on machine sub-assemblies. These sub-account numbers are grouped by the nature of the sub-assembly; that is, whether the sub-assembly is an electrical, a mechanical or a fluid system component. There are other sub-account numbers which do not fit into either of those categories and are grouped under miscellaneous. At the present time, the company has 99 of these sub-account numbers.

Third part of the code consists of a single digit and tells something about the nature of the transaction. This includes intracompany charges, supply transportation charges, purchases from independent suppliers, repairs by independent establishments, etc. The company has ten descriptions here.

In all, Pocahontas Fuel has almost 330,000 possible descriptions (combinations) at the present time. If needed, the code can be expanded to give almost 800,000 descriptions. Thus, a means has been provided to describe supply transactions briefly and accurately in a form that IBM machines can easily handle.

Figure 2 covers what the company calls "Section Haulage Equipment." The numbers on the left side are the cost account numbers. To the right of the account numbers are their corresponding alphabetic descriptions. Note that these descriptions never exceed ten letters—this limitation was necessary because of computer programming considerations. The only exception is where a total (preceded by an asterisk) is printed. In this case, the word "total" is emitted by the "407" accounting machine which printed the report. Only the code numbers were written at the time the individual transactions were consummated. The computer caused the proper description to be punched in the cards. It did this by doing a modified table-look-up operation. If there was no sub-code—all zeros in the low order positions—the account number description was punched. If there *was* a sub-code, the *sub-account* number description was punched.

The two columns of figures to the right of the descriptions are cost per ton amounts. They are for the month and for the year-to-date respectively. The computer calculated and rounded them off to the nearest hundredth of a cent.

Fig. 5. The IBM "650" computer will do 78,000 additions or subtractions per minute, 5000 ten-by-ten multiplications per minute and 3700 divisions per minute

Next two columns of figures are the amounts of money spent for the month and for the year-to-date respectively. To the right of this, month and year-to-date quantities would have been shown had this portion of the report covered operating supplies.

Five types of totals are developed in these cost reports. First sub-account totals are accumulated within a specific account. The sub-account totals are then accumulated to give a specific account total. Next all the specific account totals are added to develop the group account totals. The sum of the group account totals gives general classification totals which are further developed into a final total.

Just how would such a report be used? Logically the final total is the first figure to examine for an indication of excessive cost. All other totals should be examined in reverse order to which they were developed. For instance, from figure 2 it is seen that the total section haulage equipment cost is $0.1416 per ton for the month and $0.0992 per ton for the year-to-date (two months). Such a cost should certainly be questioned.

This is where management starts digging. First, it must determine if a particular type or all types of equipment in this group are unusually high. The costs for the month are of value, but the year-to-date costs have greater significance. For this reason, only the year-to-date figures will be used in this analysis.

Taking the equipment in the order of account numbers, it is seen that 6-SC's cost $0.0195 per ton ($4,405.15), 9-SC's cost $0.0600 per ton ($13,517.35), 10-SC's cost $0.0029 per ton ($658.27), and extensible belts cost $0.0155 per ton ($3,501.81). In other words, more than 60 percent of the expense on section haulage equipment has been on 9-SC shuttle cars.

The field of investigation has been narrowed but management must go further. The costs of various sub-assemblies must now be studied. This examination reveals the highest costing sub-assembly is wheel units at $0.0224 per ton ($5,054.69). The next highest cost is on the control panel at $0.0086 per ton ($1,938.20). This is as far as this report will allow the company to go in its effort to determine why section haulage equipment costs are so high. However, the next report to be discussed will allow management to continue from this point.

Supply Cost Report Supplement. Figure 3 is a portion of the supply cost supplement. In this report the cost of various machine sub-assemblies are broken down into costs of individual parts. The report shows the following: (1) cost account numbers, (2) part numbers in numerical order, (3) part names, (4) quantities for the month and year-to-date, (5) dollar amounts for the month and year-to-date, (6) units of issue and (7) unit prices. To return to the examination of 9-SC costs, notice that the $5,054.69 year-to-date cost on wheel units from figure 2 also appears on figure 3. However, in figure 3 it is the total money spent on various wheel unit parts. An examination of these parts shows that seven A30421 worm gear assemblies have been used during the two-month period. At a cost of $360.00 each, this is $2,535.00 or better than 50 percent

of the total wheel unit cost. Further inquiry revealed that these wheel units are being replaced after over three years in continuous service under extremely severe conditions. For this reason, no immediate action is necessary. If this high cost should continue after all the original wheel units have been replaced, further attention certainly would be required.

Figure 4 is a portion of the same cost supplement and covers the control panel. Over 60 percent of the cost on this sub-assembly ($1,167.50 out $1,938.20) represents charges for parts in work done by the company's central shop. The parts were utilized in building a spare panel board, which is to be used for the systematic replacement of boards presently in the shuttle cars.

Notice that an A31689 steering rod end is included in the list of control panel parts. This happened because of a coding error made during the first month the revised code was used. The same is also true of the RA22205-1 junction box assembly and is pointed out as something to be guarded against, especially during the first months such a system is in effect.

Supply Cost Comparison. This report is prepared at the end of the year and at any other time it is desired. It shows cost account numbers and their costs per ton at each colliery on the same line. The report is an aid to improving performance, because such inter-colliery comparisons readily show good and bad points in each colliery's cost. New objectives and the exchange of ideas are the prime benefits.

Central Shop Overhaul Report. The overhaul report is prepared monthly for work done by the company's central shop. It shows the total cost, the cost charged to each mine, and the cost charged to each machine on which work was done. These charges are all sub-divided into costs for labor, overhead, and supplies for the month and the year-to-date.

Intra-Company Supply Charges. This is a resumé of charges against supply costs by various organizations within the company each week. Each colliery is covered individually. The purpose of the report is to assist in daily cost accounting at the mine and to provide a means of detecting errors in charges.

Usage Report. It shows in numerical order machine part numbers and descriptions, quantities used at each operation, total quantities used by the company as a whole, and the average unit prices. The report is prepared quarterly for the quarter and the year-to-date, and differs from the Supply Cost Supplement in that it does not show the machine and sub-assembly types where the part is used. Some parts are interchangeable on various machine types of individual manufacturers. This is especially true in the electrical and hydraulic systems and to a limited extent in the mechanical systems of these machines. Thus, with this report management has a tool with which total usage of such parts can be analyzed. It is used in setting inventory levels and has been the basis for certain special studies which would have been impossible otherwise.

Stock Status Report. Stock transactions are reviewed each week by IBM machines. During these reviews, new inventory quantity and purchase order cards are prepared. The Stock Status Report is printed at the same time. All parts are listed on which a transaction occurred during the review period. The report shows the part number and description, the unit of issue, the old balance, receipts, issues, the new balance, the quantity on order, the total quantity on hand and on order, the established inventory level, the quantity due out, and the quantity above or below requirements. It is used primarily as an aid in adjusting inventory and purchase quantities.

Purchase Orders. Purchase orders are prepared for parts which the above-mentioned review shows below requirements. All such orders show the supplier with whom the order is placed, purchase conditions and reservations, shipping instructions, purchase order and requisition numbers, the date of the order, part number and name, the unit of issue, the quantity ordered, and the unit price. Our central warehouse storage location is listed for each part also. Suppliers are asked to show these locations on all packing slips to save binning time. The cards used in preparing purchase orders are retained as an aid in expediting orders and eventually become receipt cards.

Intra-Company Shipping Orders. These orders are prepared to facilitate filling orders and shipping parts from central warehouse. Items are listed by storage locations in the order of ascending bin numbers. This saves much time in filling orders. All shipping orders show part numbers and descriptions, units of issue, quantities ordered and shipped, and unit prices. A copy of the shipping order is signed at the receiving colliery. This signed copy serves as a basis for charges against that colliery's supply cost. The cards used in preparing the orders become issue cards and are used in the weekly stock transaction review.

Colliery Back-Order Lists. Prepared weekly, this list shows the parts and quantities which were not shipped on regular order. It serves as an aid to inventory control at the colliery supply houses.

Inventory Lists. These lists are records of the status of supply inventories. They are prepared annually for each colliery and for central warehouse, and are used for inventory control and insurance purposes.

In-Active Parts List. Prepared once a year, they show all parts with no usage for the past year, past two years, and past three years. This list is the basis for disposing of such parts to reduce inventory. Such disposal saves storage space, and reduces taxes and insurance rates.

Supply Catalogs. These are lists of supply parts with current prices. The parts are in numerical order and are grouped by manufacturer. New lists are prepared whenever enough price changes occur to warrant it.

Benefits

Action based on knowledge gained from the above reports has made considerable savings possible for Pocahontas Fuel. Some of the savings are intangible and for this reason a dollars and cents value cannot be placed on all of them. However, the statements in the following paragraphs should leave little doubt that worthwhile gains have been made.

The most spectacular saving has been on inventory investment. At one time inventory was growing at a rapid rate. This growth was halted and the investment was reduced to one-half. Without the present system, inventories would probably be two, three, or more times greater than they are at the present time. Further means have been studied whereby more reductions and better performance can be accomplished.

Other savings have been made in purchasing. Purchase orders are now written on a weekly basis for the company as a whole where it was done *daily* for individual collieries. Such bulk purchasing based on knowledge of annual requirements has resulted in price savings of 10 to 20 percent. This saving could have been accomplished by manual ordering methods but at least four more people would have been necessary to do the job.

(*Continued on page 67*)

► STRONGER

► MORE EFFICIENT

► LOWER COST

► LESS MAINTENANCE

WHY THE circular shaft ?

By

W. F. SHINNERS

Manager—Michigan Mines
The M. A. Hanna Co.

ALMOST three years ago, in Iron River, Mich., The M. A. Hanna Co. found itself faced with a decision concerning the future service at depth for two adjoining mines. To continue with present shafts would require replacement of hoists, remodeling of hoist houses and deepening of both shafts. The shafts themselves, however, were of comparatively small cross-sectional area which would severely limit skip capacity for deep hoisting. To enlarge and deepen both shafts along with the attendant remodeling of headframes would mean that each mine, in turn, would be out of production for a considerable period.

Faced with these obstacles, it was finally decided to sink a single new shaft of sufficient capacity to serve both properties. Furthermore, it was determined that the shaft should be circular in section, 20 ft inside diameter, and concrete-lined.

This was a radical departure from accepted practice in the area, and aroused a good deal of interest. Curiosity has prompted the question, "Why the circular shaft?"

The author does not pretend that the answers this article sets forth are going to constitute sufficient reason that all new shafts should be made circular. Rather, it will tell you how Hanna reached the decision in the company's own particular case.

Choice Based on Simple Considerations

The reasoning which led to the choice was not actually too complex. It seemed that, as the problems were analyzed, the present design just sort of materialized as the logical answer to Hanna's attempt to find something best suited to its needs for the least money.

The main considerations were the following:

1. Since new hoists were necessary, the type to be used was the first consideration after the new shaft had been decided upon. After weighing all the pros and cons, the Koepe system was chosen as best suited to the company's problems because of its adaptability to automatic, multiple-level hoisting; and because of the ease with which two mines, whose product must be kept separate, could be served simultaneously.

In spite of assurances that Koepe hoists would work under almost any condition, it was Hanna's considered opinion that they would operate best with least rope and other maintenance if the shaft were kept dry. Water is common in the glacial drift above ledge in the area, and it was known that the shaft had to cross a heavily faulted area, probably water-bearing, which would not only affect future hoisting, but prove to be a great nuisance during actual sinking. Consequently, a shaft from which water could be easily excluded appeared desirable.

2. Also, because of the fault zone and because of the probability of bad ground, the company wanted a shaft which offered the best support during sinking, would be strong, and would reduce shaft maintenance to a minimum during the anticipated life of the mines it serves. It seemed that a

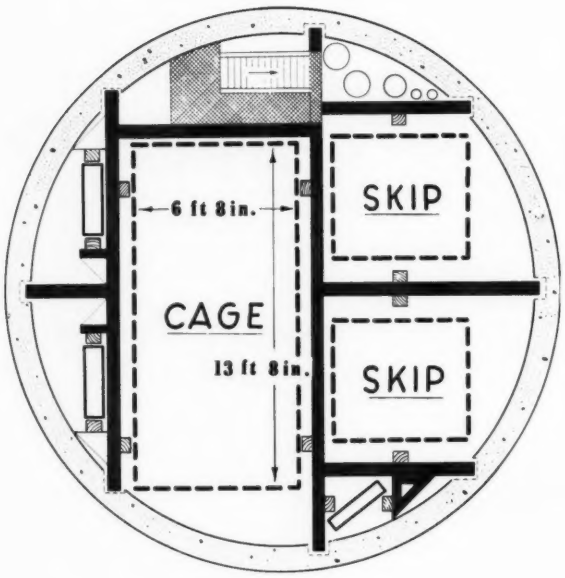


Fig. 1. Plan section of The M. A. Hanna Company's Homer-Wauseca shaft at Iron River, Mich.

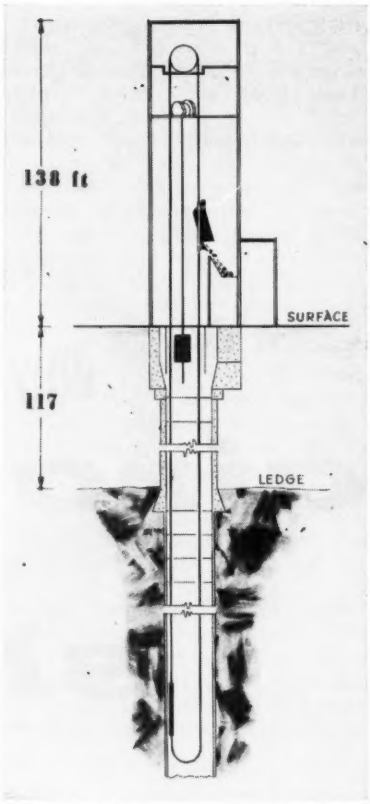


Fig. 2. Hoist arrangement and foundation design

concrete-lined shaft was the answer to these problems.

3. Hanna investigated various shafts across the country—both those in operation and others in the process of sinking—and was impressed by the way in which the circular section lent itself to modern sinking methods which should result in lowered costs; and it was obvious that the circular section offered the greater strength per unit of concrete placed with minimum labor for forming and alignment. In the light of these considerations, the circular, concrete-lined shaft began to take on considerable appeal.

One of the objections which is frequently raised against circular shafts is the claim of a lot of wasted space. This is true to a degree, depending on the size of the shaft and what is intended to be installed. However, this detail was satisfactorily settled, and a contract for the job was let to Walsh Construction of New York.

Figure 1 shows how the space was apportioned in this particular case. While there is some space that is unused, the proportion is small and since the main ventilation is to be directed down the shaft, a little additional clearance is not objectionable. Provision is made for a double-deck cage which can carry 100 men. Skips are to be of 14-ton capacity, and between the two mines will hoist 450 long tons per hour from a maximum depth of 2600 ft. Three independent hoists are used, the counterweights fitting very nicely in the space which would otherwise be vacant.

Steel Installed as Concreting Progresses

The headframe is of steel construction and is placed on a heavily reinforced concrete mat which, besides receiving support from the underlying ground, is also supported by the shaft structure that extends down to a spool effect at the ledge. (See figure 2.) Most of the concrete circular shafts which have been sunk recently are known as gun barrels—at least during sinking time—since dividing steel is placed only after the shaft is completed. In this case, however, it was decided to put in steel as the shaft progressed for several reasons.

1. It was felt that a crosshead with safety dogs was required; and on a 20-ft span, a crosshead that would be dependable would be too heavy to be practical. However, with steel installed during sinking, a regular crosshead to fit the cage compartment could be used.

2. With steel installed, there was a much better opportunity for personnel to go from the bucket to intermediate levels or required pump stations.

3. Recently adopted safety rules required that fixed ladders be carried to within a reasonable distance of the shaft bottom at all times and that a flexible ladder be provided to the shaft bottom. This ruling made it almost mandatory that the steel be carried with the shaft.

Since the shaft itself requires no internal support, the only function of the steel sets is to support the various runners, pipelines, ladders, etc. Consequently, it is fairly light in section

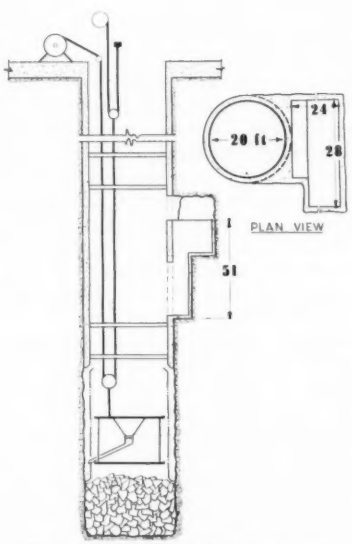


Fig. 3. System of cable suspension for work deck and concrete forms. There are three independent suspensions, of the type shown, at 120 degree intervals. Also shown is a plan view of a typical ore pocket. These pockets are located at 200-ft intervals

and placed on 10-ft centers. It is attached by bolting and welding to anchors which are cast in the concrete as it is poured.

Equipment and Sinking Procedure Described

Concrete forms used on this job are 30-ft high but can be broken down into five or ten foot sections in case the ground will not stand for a full 30 ft. These forms are never removed from the shaft. They are suspended by a cable from the surface and are loosened and dropped for successive pours. (See figure 3.)

The drill jumbo, which is manufactured locally, is a collapsible type and thus can pass through the cage compartment. It carries four 3½-in. drifters with eight-ft feeds, hydraulically controlled, each of which is able to drill through a horizontal arc of approximately 180 degrees.

Mucking is done by an Eimco 630 loader. A 3½-cu yd bucket is hoisted and dumped in the usual manner, the headframe enclosure being large enough to handle a large truck inside and thus avoiding freezing complications in severe weather.

Ten-ft drill steel is used, and the average round pulled is about nine ft. The number of holes drilled per round vary as required by the ground, but average about 70. Four rounds are ordinarily taken, the forms are dropped the full 30 ft and concrete poured. Three sets of steel and guides are then placed from the top of the work deck and the cycle repeated. The work is conducted by a total labor force of 40 men, including office, engineering, supervision, and maintenance. Five men are used on the bottom.

Best progress in any one month of three-shift, six-day operation, was 215 ft of completed shaft or an average of 8.3 ft per day. In the 12½ months preceding August 1, 1958, more than 1860 ft of shaft below ledge was completed. In addition, two stations and four pockets were cut and concreted for an average progress, including these auxiliaries, of 149 ft per month. This is not a world's record by any means, but it is satisfactory.

The company has had an excellent chance to compare costs between the circular and the conventional shaft since it finished sinking one of the latter only four years ago. It has been found that in spite of the rise in labor costs during that time, the circular shaft, which has a little larger cross-sectional area, is considerably cheaper. Hanna feels that it would still be cheaper than the rectangular shaft even if it had been sunk at the same location and the same difficulties, which beset the rectangular shaft, had been encountered.

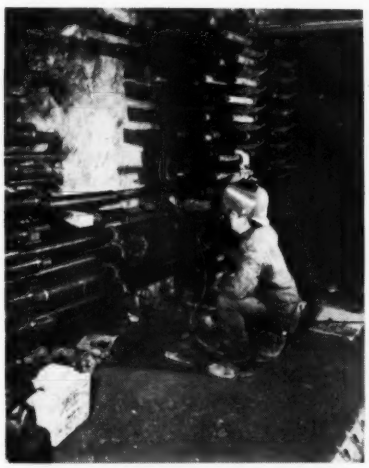
Summing up, the company's conclusion is that its decision was justified by the fact that it has a stronger, drier shaft and one well-suited to the intended type of hoisting. Officials are satisfied that it is cheaper to sink and that additional savings will be apparent in decreased maintenance after several years of operation.

Future Aspects of
MINE VENTILATION

(*Continued from page 35*)

equipping the mine fans with variable speed couplings, either of the magnetic or hydraulic types, or by installing vaneaxial fans designed with controllable pitch blades. Thus practically constant air volume can be maintained on each haulage level without changing regulation, in the face of varying outside temperature or varying underground resistance to air travel. This is accomplished by actuating the variable speed on the one hand, or variable pitch on the other, by air volume through the fan. The resulting stability of operation and freedom from conventional regulator adjustments and power savings might in certain cases justify the added equipment cost.

Ventilation of the working places on the sub-levels is recommended to be of the exhaust type (full time exhausting) with auxiliary blowers of adequate capacity located close to the heading and operating in conjunction with the exhaust system. The auxiliary blower serves to force the smoke and nitrous fumes back from the heading following shooting. The exhaust line then collects the fumes and transports them to the return aircourse maintaining clean smoke-free air throughout the entire length of the sub-level tunnel. Of course proper provisions should be made to provide sufficient heading air to maintain approximately 50 ft/min air speed necessary for effective scavenging.



Air cooling will play an increasingly important role in future mining operations. Shown is the core of an underground heat exchanger under construction at the Homestake mine, Lead, S. D.

Under certain conditions of extreme rock temperatures or wet tunnel the exhaust system should be abandoned in favor of a straight blowing system with short exhaust periods following blasting. This never affords the smoke-free tunnel obtained with an exhaust system, but it is necessary under the aforementioned conditions.

An exhaust system maintains absolute air pressure throughout the mine below atmospheric pressure. Conversely, a pressure system maintains absolute air pressure throughout the mine above atmospheric pressure. In either case, atmospheric pressure is defined as the absolute air pressure that would exist at the location in question without the fans operating.

In either case, the downcast air undergoes heating by adiabatic compression to the extent of 5.35° F. per 1000 ft of descent. This compressive heat is beneficial when it becomes necessary to heat the intake mine air in winter, but imposes an additional thermal load upon the refrigeration system when in operation.

An exhaust system is favorable to the refrigeration system in that the heat of fan compression is not superimposed upon the cooling system as in the case of a pressure system.

It is presupposed that the hypothetical mine under discussion takes full advantage of underground air recirculation with proper filtering, modern ventilation equipment, air-cooling; and if necessary, adequate air at all headings for smoke and fume scavenging, proper dust control etc. If so, it necessarily follows that the mine is under alert, progressive management and, in all probability, overall mining costs will be found to be as low as is consistent with prevailing local natural conditions.

Early in 1958 Marling J. Ankeny, director of the U. S. Bureau of Mines, appealed to manufacturers and the coal industry to help in preventing explosion disasters by starting research and development programs to produce a methane detector system that would provide automatic protection against dangerous concentrations of methane. This progress report indicates that the mining industry will soon have such a system available

A Continuous Methane Monitoring

By

R. S. JAMES

Chief, Branch of Electrical-Mechanical Testing
U. S. Bureau of Mines, Pittsburgh, Pa.

THOSE of us who have been in the mining industry for any length of time have known of or have heard of numerous explosion disasters in which many men have lost their lives and much property damage resulted. Even today this explosion hazard exists as one that can snuff out many lives in a matter of moments. This is a situation that must be faced, for most coal mines have some gas and many liberate methane at a high rate. For many years ventilation has been counted on to keep the concentration of methane below the lower explosive limit. Good ventilation and proper rock dusting are the best saefguards against explosion disasters, but the men who have done investigative work after explosions know that, for one reason or another, ventilation has failed to carry the gas away, and thus the stage is set for disaster.

Many times the question has been asked: "Can anyone tell of a system of ventilation that will guarantee under all conditions, and at all times, that there will not be an explosive atmosphere of methane?" This question has never been answered affirmatively. It is necessary to be prepared at all times for the possibility of explosive mixtures of gas being present, particularly in the working areas.

Prevention of Explosions

Actually, to have an explosion fuel, oxygen and heat must be present. Since the men must have oxygen, air is necessary. Then explosions and fires must be prevented by keeping the fuel in the proper proportions, and preventing heat from starting a reaction of fuel and oxygen. Fuel in the form of coal dust can be taken care of by rock dusting properly. Fuel in the form of methane should be diluted below the lower explosive limit by a sufficient amount of air. The heat necessary for ignition can be avoided by keeping surface temperatures below a safe limit and by using explosion-proof enclosures for arc-producing equipment, such as motors and controllers. To the uninitiated in mining, this might sound like a very simple and positive procedure for preventing mine fires and explosions. This is not the case. In the haste to get production, accidents can happen, maintenance can be neglected, and carelessness can set up the right combination of conditions for a disaster. Nature is quite generous with us in permitting certain errors without trouble, but even Nature loses patience at times, so we must not tempt fate too far.

With the advent of concentrated mining methods using continuous mining machines, the ventilation problem became more acute than ever. Even though the gas concentration is checked at the required intervals with a flame safety lamp or methane detector, this still is not enough to guarantee safety. Various investigations by the Bureau of Mines and others have brought out facts regarding rates of liberation of gas, concentrations at various points, and air flow required for proper dilution. Even more work is necessary in this connection. Perhaps if a man were assigned to check continually with a flame lamp or methane detector, the concentration of methane in the atmosphere would be known and explosions could thus be prevented. This has never been proposed, and it certainly does not seem to be a practical idea.

A New Approach to the Problem

Because several disasters have occurred in recent years, Marling J.

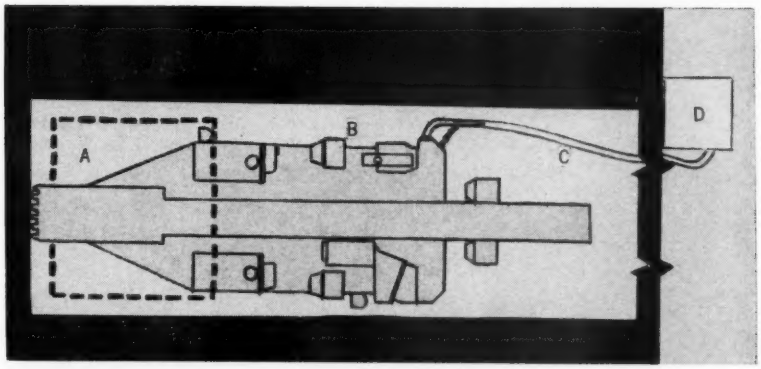


Fig. 1. Plan for a continuous methane-monitoring system applied to a continuous mining machine. Area "A" enclosed in the dotted rectangle indicates the approximate location where the atmosphere will be sampled. An indicator box with the desired controls and equipment probably will be located near the machine operator at "B". "C" indicates the trailing cable over which a signal doubtless will be sent back to the distribution box "D" to control the shutoff feature of the methane-monitoring system

System at the Working Face

Ankeny, director of the Bureau of Mines, gave this considerable thought and concluded that something special is needed to prevent this useless loss of life and property. On February 12, 1958, the director called a meeting at the Bureau's Pittsburgh Station in an effort to solve this problem. Among those present were men from the mining and electrical industries familiar with mining problems, representatives from the electronics and instrumentation fields, members of the United Mine Workers of America, coal operators' associations, some independent coal operators, and members of the Bureau's staff.

The director appealed to these representatives to help in preventing explosion disasters by starting research and development programs to produce a methane detector system that would provide automatic protection against dangerous concentrations of methane. Ankeny outlined his concept of a continuously monitoring methane system as a detector that would be mounted on face-area mining machinery and would sample the mine atmosphere constantly while electric power was supplied to the section from a trolley nip or power center. This detector would be designed to give a warning when the atmosphere at the detector contained 1 to 1.5 percent methane. If the concentration reached 2 or 2.5 percent methane the detector would automatically activate controls that would shut off the electric power at the proper point. To help overcome the difficulties of such an undertaking, the director offered such technical assistance as the Bureau has available, as well as the facilities of its laboratories and equipment, to any company interested in the project. The idea was received as a step forward in the interest of safety in gassy coal mines, and several companies have accepted the challenge to design such a system.

Procedures

To encourage development of a continuously monitoring methane-detector system, the Bureau of Mines informed manufacturers that they did not necessarily have to develop an entire system. For example, it was explained that electronics and instrumentation concerns familiar with gas detection, could develop a sensing unit only capable of detecting methane-air mixtures, and leave the problem of transmitting a signal to shut off power to others more experienced with this type of electrical problem. Thus, two or more companies or other organizations may combine products to present a "package" system to the Bureau for permissibility inspection, tests, and final approval prior to offering it to industry. A manufacturer may, of course, develop an entire system if he so desires.

Qualified Bureau of Mines personnel is available for consultations, recommendations, literature references and technical advice on problems regarding permissibility requirements, tests and approvals. When a company completes an experimental or working model and desires to test its workability, the Bureau is authorized to make the necessary laboratory studies and to arrange with mine operators to field test it. Bureau engineers, who conduct these tests, will then make such recommendations to the company on the basis of the test results as may be required to obtain final approval.

Final approval of systems will be issued by the Bureau in one of several ways. If a company develops a complete system and meets all the requirements for permissibility, the Bureau will issue the approval to that company. If two companies combine to present a "package" system to the Bureau, components may be certified to each participating company, and final approval may be issued to one of the companies or to the mine operator when the system is installed on his equipment. Approval may also be obtained by a company that manufac-

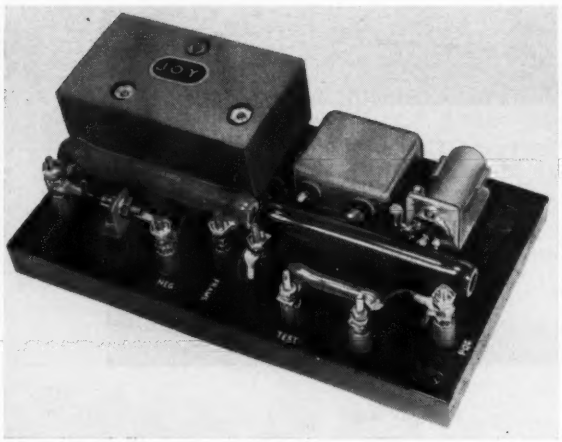


Fig. 2. Oscillator panel for "Lectronic Sentry"

tures mining machinery by having the system integrated into its machine as a part of the product. In any case, the Bureau will issue approvals for a complete system only. For the purpose of developing new components under field use, *permits* may be issued for a period of six months after tests and inspections disclose that the equipment is safe for use in gassy and dusty atmospheres.

Preliminary Requirements

Figure 1 shows an elementary plan for a continuous methane-monitoring system applied to a continuous mining machine. The area "A" enclosed in the dotted rectangle indicates the approximate location where the atmosphere will be sampled. An indicator box with the desired controls and equipment probably will be located near the machine operator at "B." "C" indicates the trailing cable over which a signal doubtless will be sent back to the distribution box "D" to control the shutoff feature of the methane-monitoring system.

One of the first important duties of the Bureau was to establish a set of "ground rules" or guides for interested manufacturers to follow in their research and development programs. The most important of these rules, called design suggestions, follow:

1. Components of the system shall be enclosed in explosion-proof housings, unless the component operates in an intrinsically safe manner.

2. A system shall provide an indicating point at one methane concentration and one cutout point at another concentration.

a. At the lower indicating point a light shall flash or an audible sound shall be emitted. These light or audible indications shall be such as to attract positively the attention of the operator or other authorized person. The light or audible signal shall operate at one percent (+0.5, −0.00) methane.

b. The power cutoff at the nipping station or load center shall occur at 2.5 percent (+0.00, −0.50) methane.

All these operations shall be accomplished in a "fail-safe" manner.

3. This system shall be so arranged that, in case of detector failure, the electric power shall automatically be shut off. Provision shall be made to indicate continuously that the detector is in operation, so that, if the detector fails, the operator or other authorized persons will be aware that the power shutoff is due to failure of the detector.

4. If dust filtering is necessary, a minimum of one-month performance is required before cleaning or changing.

5. The device must sample the atmosphere continuously.

6. In no instance shall the point or points of sampling be less than 12 in. from the roof or rib. The sample shall not be taken closer than 12 in. from the face and not farther away than 15 ft from the face end of a machine. The sample should be taken so as to obtain a representative or integrated specimen of the atmosphere in the general area of the machine. If necessary, the Bureau *may* require two or more sampling points, and at least one of the specimens must be taken from the return-air side of the machine.

7. An arrangement shall be provided that will shut off the electric power at the supply end of the trailing cable when the continuously monitoring methane detector functions in a 2 to 2.5 percent methane-air atmosphere. The Bureau desires that this be accomplished by some method, such as sending a signal back over the power conductors of the trailing cable, so that the arrangement will also serve as a power shutoff for trailing cable faults. The circuit for transmitting the signal from the detector breaker or power supply must be so designed as to "fail safe."

Progress to Date

A Federal schedule of regulations covering all requirements to be met by manufacturers for permissibility of a system or certification of components is being drafted. This includes specifications for explosion-proof housings, cable entrances, methods of attaching the system to the source of power if needed, and various tests to determine the safety and adequacy of the system.

A few companies are interested in working with the Bureau to experiment on new catalytic techniques to oxidize methane at temperatures lower than present-day methods. The Bureau is impartial to any method of detection, provided it meets all requirements, but is constantly looking for better and simpler ways to detect methane. Meanwhile, the Bureau is obligated to cooperate with private industry to achieve the desired goal of obtaining a practical methane monitoring system to improve safety in highly mechanized gassy coal mines.

The Bureau is continually searching literature for past, present, and new methods of detecting methane and all information of value to this project. A table listing various known methods of methane detection is provided at the end of this paper.

Some brief studies have been made of the problem of filtering dust from the sample of atmosphere. Details are available to anyone interested. Bureau engineers are convinced that, due to the small amount of sample required by most devices, the dust filtering will not be a major problem.

Some preliminary discussions have been held regarding the problems of vibration. The effects of vibration will be much more important with certain types of devices than with others. Certainly vibration will be considered in developing the various devices; but field experience will, no doubt, be needed for final refinements.

At this time the progress known to have been made by the various manufacturers is as follows:

(1) One manufacturer has developed a detector alarm combination

based on the velocity of sound through different gases. A breadboard model has been demonstrated and shown very good results. The suitable alarms and power-shutoff relays and other equipment can be readily operated from this device.

(2) One manufacturer has developed a methane-alarm device based on catalytic oxidation of methane. A breadboard model has been demonstrated; since that time new, improved ideas have been incorporated, and it is expected that this device will soon be ready for Bureau of Mines laboratory tests.

(3) One manufacturer has developed an electronic device suitable for use as a power-shutoff component. This device will also serve as a protection against hazards from many types of cable failures. One form of this device has been accepted by the Bureau as a substitute for trailing-cable ground conductors after thorough testing.

Figures 2 and 3 show some details of a power-shutoff system. This part of the methane-monitoring system has been developed by the St. Louis Division of Joy Manufacturing Co. The device will serve as protection against trailing-cable faults and also to avoid excessive build-up of voltage on a machine frame, since it was originally developed for this purpose. Figure 2 shows the oscillator panel to be mounted in the machine controllers. Figure 3 shows one arrangement of the receiver unit with circuit breaker.

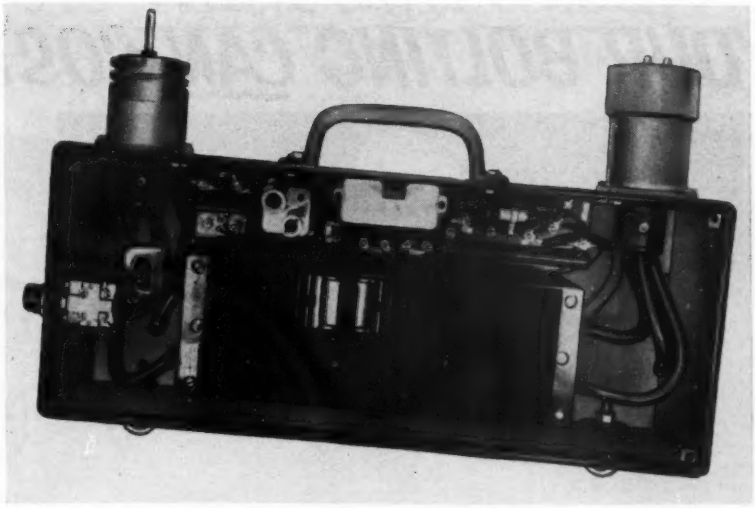


Fig. 3. Receiver unit and circuit breaker for fresh air power cutoff

(4) Several manufacturers have shown devices that may be of value in this program. Others have been interested in developing devices. In many such instances, the status at present is not known.

Table 1—Summary of principles employed in detecting methane in methane-air mixtures

Principle used for detection	Name of detector	Method of obtaining indication of methane present
Combustion by flame	Safety lamp	Increase in height and width of flame cap is measure of amount of CH_4 in air.
Hot-wire combustion	McLuckie	Methane is indicated by reduction in pressure within combustion chamber.
Do.	Droeger	Do.
Do.	Ringrose	Do.
Do.	Westhoff	Measurement is accomplished by hygroscopic determination of water formed in combustion.
Do.	MSA W-8	Measurement is obtained by utilizing increase in wire resistance due to combustion.
Do.	Leon-Cerchar	Do.
Difference in thermal-conductivity of air and methane-air	Hartmann and Braun	Methane is indicated by measurable resistance difference of a filament heated in methane-air and one in air alone.
Do.	MSA Thermal Conductivity Detector	Do.
Difference in density of air and methane-air	Nellissen PS50	Methane determined by exchange of gas between two chambers containing different gases and separated by porous wall.
Do.	Bunsen-Schilling	Methane content determined by use of law that density of two gases is inversely proportional to square of velocity of efflux, from a small orifice and directly proportional to square of efflux time.
Difference of index of refraction of air and methane-air	Riken	Interference of light source through a prism by methane-air compared to spectrum in air as measure of methane.
Do.	Zeiss	Do.
Difference of velocity in sound	Mostly experimental	Methane is measured by determining velocity of sound through methane-air compared to air.
Infrared absorption of methane	MSA and others	Methane can be determined by change in percentage of transmitted waves due to absorption by methane.
Catalytic oxidation of methane	Now used in conjunction with existing detectors	Certain catalysts aid oxidation of methane for combustion purposes. Research is necessary for low temperature types.

Bureau of Mines Research

Aside from extensive search of the literature, Bureau of Mines research so far has been involved mostly with study of catalytic methods of detecting methane. Some of this work has been done to supplement information obtained from Alan R. Baker of Sheffield, England. Catalysts are being used on platinum and other filaments, and the effects of catalyst coatings on thermistors will be studied. The results obtained with the special catalytic filaments have been very encouraging. Tests have shown a longer life than has been expected from past experience; and, so far, accuracy is as good as when the tests were started.

What Does the Future Hold?

We feel that progress so far and the materials available at this time indicate that the mining industry will soon have a permissible methane monitoring system available.

From a practical standpoint, this will mean that the industry will be able to have the methane content of the mine air indicated automatically at all times. At present men are re-

(*Continued on page 97*)

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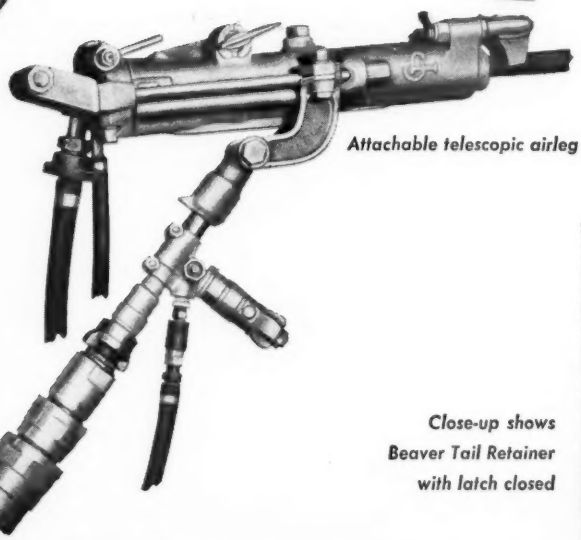
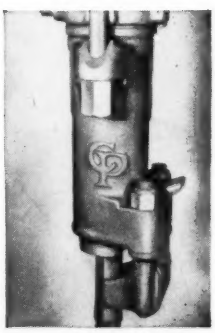


Attachable telescopic airleg for CP-69 Sinker



Close-up shows Beaver Tail Retainer with latch closed

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

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View of Anaconda's Berkeley pit, Butte, Mont., looking northwest. Waste disposal is on right, vein mines in background. City of Butte is to the left of picture

BERKELEY PIT OPERATION

THIS article deals with the development, design, and operation of the Berkeley open pit mine at Butte, Mont. It is the latest copper producing unit to become operative for The Anaconda Co. and adds a new type operation in the Butte area. The pit augments production of the deeper vein type mines and the Kelley block cave mine.

By

E. I. RENOUARD

Vice President in charge of Western Operations

The Anaconda Co.

Stripping operations started in March 1955. First ore was shipped December 19, 1955. Through August 31, 1958, 11,115,503 tons of ore have been shipped and 46,572,360 tons of waste removed.

Pictures courtesy of L. F. Bishop, Research Engineer, The Anaconda Co.

A general over-all picture of the operation is given in this article with very little space given to details, location, or history.

Location of Pit

The Berkeley pit is situated on the southeast flank of the Butte Hill. The elevation of the rim of the pit varies from 5600 to 6100 ft above sea level, and the pit bottoms out at 5100 ft above sea level in that part of the pit under discussion. The pit will be extended eastward in the near future.

Several factors have made the Berkeley pit operation possible. Availability of improved large rock

handling equipment; studies of old geological records and incomplete sampling data on file in the Geological Department, and knowledge of low-grade, secondary-enriched copper sulphide ore near surface are some. In addition, development work in the Kelley mine indicated a great amount of low-grade copper ore which was near the surface, but was too low grade to mine by block caving, or had a height of column too small to warrant the cost of developing for caving. Additional new data were accumulated from crosscuts and churn drill holes to verify the above information. Churn drilling was continued to delimit the ore body. Holes were drilled on a grid spaced at 200-ft intervals.

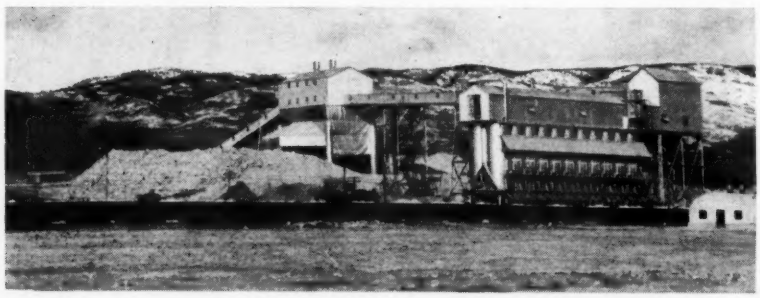
A standard churn drill hole sampling procedure was adopted to meet conditions encountered in the Butte District. Since the leached capping is barren and sampling was proven unnecessary, general practice was to commence sampling in each hole at approximately 25 ft above the anticipated sulphide zone. The holes were sampled for each five-ft interval thereafter. The cuttings, sludge, and water, after bailing from the hole, were put through a sample splitter several times and the sample reduced to two units; one sent to the Metallurgical Research Department at Anaconda, and the remaining half sent to the assay office to determine the percentage of total copper, acid soluble copper, silver, and the specific gravity of each sample.

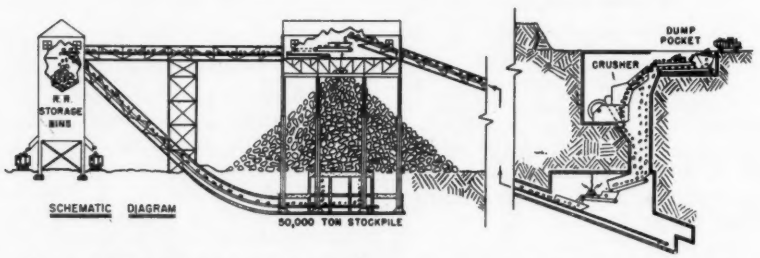
Graphic logs on a scale one in. equals ten ft were prepared by the sampler at the drill rig for each hole as the drilling progressed. Washed-panned drill cuttings were dried and cemented on the left side of the heavy paper log strip, and individual sample assays, ore averages, and waste averages were posted on the strip by the geologist as assay returns were received.

A total of 268 holes averaging 612.7 ft deep and aggregating 164,-210 ft were drilled. In these holes the average leached capping thickness is 275.1 ft, and the ore thickness averages 175.6 ft.

With the knowledge gained, a pit was designed by the Geological and Mining Engineering Departments. Cross sections and longitudinal sections were made along the churn drill hole grid lines. These sections show the churn drill holes and assays, old mine workings, and mapped and projected geological information. From these sections and with plan maps on each bench, a pit was designed to mine the greatest amount of ore with the minimum of waste removal. The sides of the pit were designed for a 45-degree slope, with fifty-ft berms between benches. It was determined a 33-ft bench gave the greater efficiency in blasting and mining with the equipment used and the working conditions in the pit. All haulageways in the pit were designed for a seven-degree maximum grade because of adverse winter conditions. Waste dumps are run on a four-degree plus grade. Close engineering control on all mining activities is necessary to develop the pit according to plan and to maintain ore production at the desired grade and tonnage level.

In estimating the ore reserve, the churn drill holes were plotted on each bench plan map, together with the average assay grade for the 33 ft of hole or bench height. To determine the area to be represented by each hole assay average, polygons were constructed around the hole by plotting perpendicular bisectors of lines between the hole and the other adjacent holes, and extending the bisector to intersect with other bisectors. Thus the area around the hole is bounded by a polygon whose sides are midway between all other holes. The area is determined with a planimeter and the volume and tons calculated using 11.5 cu ft per ton. A total of 131,114,904 tons of ore averaging 0.75 percent copper and 0.17 oz silver remain in reserve on January 1, 1958. In order to mine this ore, 151,-581,859 tons of waste and 41,381,-205 tons of leach material averaging 0.2 percent copper will be removed. Thus the stripping ratio is 1.47 to 1, using a 0.5 percent copper as a cut-off point between ore and leach ore.





Ore handling system consists of truck dumping facilities, a screening and crushing plant, five main conveyor belts, stockpiling equipment, storage and railroad car loading facilities capable of handling 2000 tons of ore per hour

Service Facilities for Mobile Equipment

An important part of the planning for the Berkeley pit operation included complete facilities for the repair, servicing and maintenance of all of the mobile pit equipment.

The layout includes the pit offices and change house, main shop building housing the main service bays, various sub-repair rooms, warehouse office, tool room, shop office and sanitary facilities; a warehouse building for heavy equipment, a combination paint shop and wash rack, fuel storage tanks and pump house, fuel dispensing facilities and an electric heater island for plugging in heaters on parked trucks during the cold weather to enable easy starting.

All of the facilities are located on a well-drained flat area, 720 ft wide by 1000 ft long, and are surrounded by an eight-ft cyclone fence. The whole area is well-lighted for night time operation.

The office building houses the pit superintendent, foreman, shift bosses, powder foreman, engineers, timekeeper and superintendent's clerks on the lower floor. On the upper floor is a modern change room with steel

wire baskets for 400 men, as well as shower baths and toilets. The building is well-lighted, heated and ventilated.

The main shop building is a steel structure covered with steelbestos siding outside, insulated with 1½-in. fiberglass, and covered on the inside with corrugated galvanized iron. The building is 360 ft long, 90 ft wide and is divided into two parts. The main shop is 50 ft wide by 340 ft long and has a clear height under the crane of 28 ft. The sub-shop area is 40 ft wide and 300 ft long. The main columns of the building are on 20-ft centers so that 20-ft wide bays are possible. This allows ample room for one 50-ton truck in each bay with enough room around the truck so that any major repairs can be made.

Starting at the south end of the main shop area, the first two bays are reserved for tractor, grader and drill rig repairs. The next thirteen bays are for trucks and the next two bays contain the grease pits and lubricating equipment. Provision was made in the third bay from the south end of the building for tire maintenance and repair. Tools and equipment for servicing the large tires are located in this bay. Complete records are kept of all the tires on all of the equipment.

The two lubricating bays run the full width of the building so that there is room to grease and service four trucks at a time. The trucks can be driven right on through the building when serviced and do not have to back out of the pits.

The last bay on the floor level houses the oil and grease room, a lunch room, sanitary facilities and an electric shop. The upper floor of this bay has a large well-lighted office for the clerks and an office for the garage superintendent.

Again starting at the south end of the building in the sub-shop area, the first 80 ft comprise the plate and welding shop. The next three shops are for transmission, differential and brake repair. The next two shops house the tool room and spare parts room. The next two shops are for converter, fuel pump and injector repairs. The last 80 ft are for engine overhaul and testing shops.

Just outside the north wall of the main shop are two 10,000-gal motor oil tanks, one for number 20 motor oil and one for number 30 motor oil. These tanks are underground in a concrete room. Here also air-operated pumps pump the lubricating oil to the grease pits. Fuel is stored in the northwest corner of the yard and consists of two 10,000-gal gasoline storage tanks which are underground. Four vertical above-ground diesel oil tanks of 20,000 gal each store the diesel fuel. Three of these tanks are used for number 2 diesel fuel and one for number 1 diesel fuel. The number 1 diesel is used for the General Motors diesel equipment and for blasting in the pit. A pump house is located near the fuel storage tanks for pumping the diesel fuel. Each gasoline tank has a vertical turbine pump mounted on the top flange of the tank.

Interior of Berkeley pit garage. The main shop is 50 ft wide and 340 ft long. Main columns of the building are on 20-ft centers which allows ample room to service one 50-ton truck in each bay

At the present time motor oil, gasoline and diesel fuel are received in railroad tank cars which are spotted on the Northern Pacific Railway spur next to the pump house. Motor oil and fuel are pumped to the storage tanks from the railroad cars. Provision is also made to receive oil and fuel in truck transport tanks by means of a by-pass suction line at the pump house. The pump house is a concrete building and contains four motor operated oil pumps. All of the fuel is filtered and dehydrated as it leaves the pumps on the way to the fuel dispensing stations. Explosion-proof motors, starters and wiring are used throughout.

One bulk fueling station is located to the south of the pump house and contains three filling units with meters and ticket printers for loading the 4000 gallon fuel tanker.

To the east of the pump house and north of the main garage are located three dispensing islands to service the trucks. Two are for diesel fuel and can service four trucks at a time. The next island is for gasoline. Complete records are kept of all fuel and oil received and of all fuel and oil charged out to each unit.

The wash rack and paint shop are at the extreme north end of the yard. This is a steel frame building covered with steelbestos corrugated iron and insulated with fiberglass. The wash rack is equipped with a number 300 Malsbary high pressure combination steam cleaner and also a portable Malsbary steam cleaner that can be taken into the pit to clean the shovels, cats and drills when repairs are necessary in the pit.

About two hundred ft east of the main shop building is an outdoor engine heating station where two 2500-watt heaters mounted on each truck receive electric power. This system assures easy starting during the cold winter months.

Pit Crushing and Conveyor System

To handle the ore from the pit, a plant was designed comprising a series of installations consisting of truck dumping facilities, a screening and crushing plant, five main conveyor belts, stockpiling equipment, storage and railroad car loading facilities capable of handling 2000 tons of ore per hour.

At a point just south of the Great Northern Railroad, a tunnel was driven approximately 700 ft northerly on a 12-degree incline terminating 160 ft directly under the crusher site. The north 100 ft of this tunnel, which for the greater length is 8½ by 13 ft in semi-circular cross-section, was enlarged to 18 by 40 ft to accommodate the mechanical and electrical installations necessary at this point of transfer in the system.

The tunnel was driven by conventional mining methods in so far as drilling, blasting and mucking were concerned. The muck, however, was transported up the twelve degree incline by six-yd Koehring Dumptors equipped with "scrubbers".

The tunnel was terminated at this specified horizon below the crushing plant to provide the difference in elevation necessary to satisfy the plant design. The top 60 ft in depth was required to accommodate the truck hoppers and feeders, the vibrating screen and the crusher proper. The connecting 60 ft between these two excavations is a sixteen foot diameter concrete and rail-lined raise that serves the dual purpose of storage and surge bin.

South of the Great Northern Railroad, except for that section under the stockpile, the conveyor system is above ground and is housed in a structural steel gallery that is supported by five steel towers varying in height from 60 to 90 ft. This gallery terminates at the railroad storage bins.

In tracing the rock flow from truck to railroad car, we will start at the truck dumping site. The trucks may dump simultaneously at any one of three stations. The east and west stations are for general run of pit rock. Here the ore is dumped on the main 5 by 30-ft pan feeder where it is fed over the 6 by 14-ft vibrating screen that segregates the minus eight in. material and propels the larger material on into the crusher. The north dumping station is for gob rock that contains timber from old workings. This material is deposited on to a 13-bar, five ft wide wobbler feeder that screens out the minus eight-in. material and forces the oversize rock and timber toward the pan feeder. At the point of discharge from the wobbler, the timber is picked from the ore stream and the oversize rock continues on with the general run of pit rock to the crusher.

This crusher is the largest of its type in our part of the country. It is a 60 by 84-in. Blake type jaw crusher capable of crushing 800 tons of ore per hour at an eight-in. setting. This crusher was manufactured by the Birdsboro Manufacturing Co. of Birdsboro, Pa., and weighs approximately 255 tons.

The minus eight-in. material segregated by the wobbler is deposited onto a 60-in. conveyor belt and is discharged into the surge bin. The undersize from the vibrating screen, and the oversize that goes through the crusher and is reduced to minus nine in., are also deposited in the surge bin, thus making certain that all material reaching the conveying system is minus nine in. At the bottom of the surge bin is another 5 by 30-ft pan feeder that feeds the ore over a set of grizzlies and onto a 6 by 30-ft flat picking belt where the undesirable foreign material and tramp iron that might cause damage to the belts are extracted from the flow of ore. Tramp iron detection and extraction are accomplished by means of an electronic detector connected in series with the picking belt control, and a 60-in. electro magnet at the end of the belt.

The flow of ore from the picking belt is discharged over another set of grizzlies onto the number 1 belt. This 48-in. belt operates at 400 fpm on a 12-degree incline and is the longest belt in the system, the overall length being about 2126 ft. It is powered by a double 300 hp tandem drive. This belt will discharge either onto the number 5 shuttle belt and on through the system to the ore bins or into the stockpile. The shuttle belt is 5 by 20-ft and is mounted on a movable structure that can be shuttled in or out of rock carrying position to suit the operation.

Storage for 5000 tons is provided at the railroad car loading site by a double row of circular steel "V" bottom ore bins. The 70-ton gondola type ore cars are loaded from either side of the bins by means of 44 pneumatically operated gates.

Additional storage is provided in the form of a stockpile area north of the railroad loading bins. This stockpile is placed over a reinforced concrete underground structure approximately 60 by 70 by 35 ft high that is capable of withstanding the pressures created by the 35,000 tons of ore that at times are stored here. Housed in the four corners of this structure are four 5 by 24-ft pan feeders equipped with 60-in. dribble belts that draw down the stockpile as desired, loading it onto the number 3 conveyor belt to be transported to the 5000 ton bins for loading.

The tripper that works in conjunction with the conveyors is mounted on a carriage that travels back and forth over the length of the bin, controlled as to dumping position either manually or automatically.

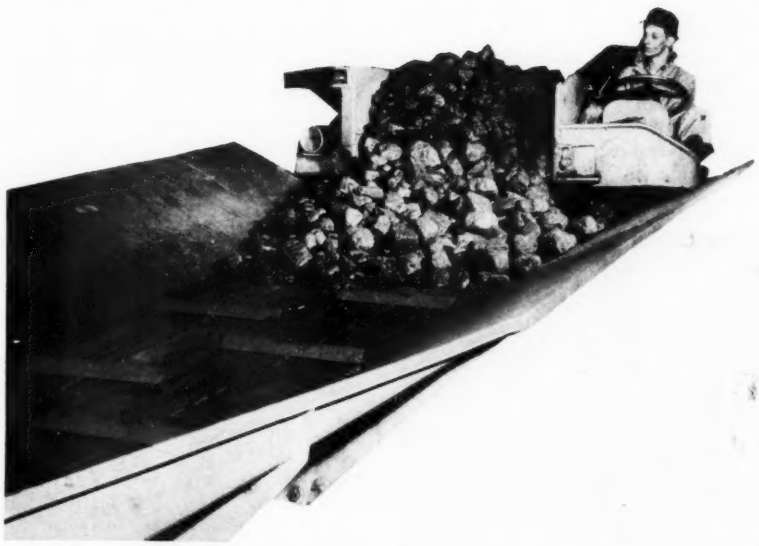
The entire system is operated from three independent control stations. Station number 1 is located in the transfer tower at the junction of number 2, 3, and 4 conveyors. Station number 2 is located at the picking belt near the loading point of number 1 conveyor, and number 3 station is located at the crusher. The control panel at station number 3 controls the crusher, the vibrating grizzley, the wobbler belt and the 5 by 30-ft pan feeder. The wobbler is controlled manually to allow the numerous stops and starts necessary to facilitate picking the timber from the ore stream.

(*Continued on page 60*)

Close engineering control of all mining activities is necessary to develop the pit according to plan and to maintain ore production at the desired grade and tonnage levels. Shown is a section of the pit where a seven-hole blast has just been fired. Average yield is 5.35 tons per lb of powder. Bench height is 33 ft; all holes are drilled seven ft below grade. The sides of the pit were designed for a 45-degree slope with 50-ft berms between benches

IMPROVING PRODUCTION

A shuttle car-to-belt feeder has enabled Warner Collieries to reduce shuttle car discharge time from 30 to 80 percent, depending upon belt size and speed, and the capacity of the shuttle car.



By

MYRON KOK

Vice President
The Warner Collieries Co.

with a Newly Designed Transfer Feeder

THE coal industry knows this fundamental to be true—increase productivity and costs will decrease. This article will be concerned with increasing productivity with the Ratio-Feeder developed by Columbus McKinnon Chain Corp.

Considerable work, experimentation and time study has been done in developing high capacity loading machines and continuous mining machines. Much has been done to develop haulage systems to haul the coal away from the loading machines and continuous mining machines. However, the intermediate link of shuttle car haulage to belts or mine cars has suffered from lack of attention. There was an apparent void in finding a suitable link between dumping a shuttle car directly on a belt or dumping it directly into some type of feeder and getting full benefit from the minimum discharge time of a shuttle car.

History of Belt Feeders

As mechanical loading passed through its various development stages, the loading machines first loaded directly into mine cars. Loading machines were built to speed up hand loading operations. Because mine cars were already at hand, it was simple to convert to loading directly into them with the loading machines.

Some of the enterprising operating people then visualized that it might be better to do away with track loading machines and develop a caterpillar-mounted loading unit. Shortly afterwards the rubber-tired shuttle car was developed. When shuttle cars were used to dump into large mine cars, there was no problem with the discharge rate of the shuttle cars. The mine cars would accept the coal as fast as it was dumped.

With the introduction of belt conveyors underground, the industry soon found itself using the shuttle cars for dumping coal directly on the belt conveyors. This practice is in vogue at many mines at the present time.

A few years ago some operators realized that shuttle car dumping onto a belt presented problems. The principal one was the added discharge time required because of the necessity of jogging the discharge conveyor to keep from overloading the belt conveyor. Jogging in turn created some clutch as well as electrical maintenance problems.

Several attempts were made by equipment manufacturers to solve the problem of discharging shuttle cars onto belt conveyors.

A chain type of feeder and a shaker type feeder were developed. The chain type of feeder consisted of three sections—the ramp, sliding carriage,

and the elevated discharge. The shuttle car loaded with coal drives up the ramp, onto the sliding carriage which takes the front wheels of the shuttle car to the forward end of the hopper. The shuttle car then discharged its load at full speed and at the same time backed off the conveyor. A chain conveyor in the bottom of the hopper carried the coal onto the belt.

The shaker belt feeder consisted of a shaker conveyor drive, a troughing pan of suitable length and a large flat hopper. The hopper was used to take the shuttle car load. The shaker feeder had some advantage over the chain type feeder because a shuttle car could dump over the end or either side of the shaker feeder. It was generally limited to shuttle cars having a capacity of not more than five tons.

Both of these feeders were tried at numerous mines and by a slow process of attrition were taken out of service. These units did not adequately solve the belt feeding problems. The moving of these feeders appeared to be the most troublesome. However, in the author's opinion, the reason for the lack of interest in feeders was the lack of understanding and comprehension of the importance of the feeder in the face cycles.

Belt feeders were summarily dropped by manufacturers and coal operators and in 1955 some additional experimenting was done with single chain and flight conveyors.

In December 1955 Columbus McKinnon held the opinion that accurately pitched, case hardened alloy link chain had an excellent application as conveyor chain in the mining industry. The company felt that its chain had advantages of longer life, greater ruggedness and lower cost, and to introduce this chain to the mining industry it decided to develop a belt feeder.

A single chain feeder was built and field tests immediately indicated that the intake capacity to remove the coal from the shuttle car was inadequate. Severe choking problems were encountered in reducing the flow of coal so as to prevent belt overloading.

Fig. 1. Designed with two converging chains, the Ratio-Feeder has a wide, high capacity conveyor at the intake end and converges to a narrow, lower capacity conveyor at the discharge end. The unit provides the necessary high intake capacity and volume for temporary storage of coal in the hopper, and a narrow, low rate of discharge for good belt loading

To overcome these problems, a feeder was designed with two converging chains. This feeder has a wide high capacity conveyor at the intake end and converges to a narrow, lower capacity conveyor at the discharge end. The feeder provides the necessary high intake capacity and volume for temporary storage of the coal in the hopper, and a narrow, low rate of discharge for good belt loading.

Engineering Approach to Sales

An unusual approach to development of the feeder was taken by Columbus McKinnon. Because its experience with mining equipment, coal mines, and operating problems in general, was very limited, the company decided to retain the services of Eavenson, Auchmuty and Greenwald, consulting mining engineers, to evaluate the economic value of belt feeders, and also determine the overall design specifications for satisfactory belt feeders.

This outside study disclosed the many aspects and magnitude of belt feeding problems. Performance characteristics were determined and Columbus McKinnon had a full and complete story before it decided to make this equipment available to the mining industry.

Function: To Provide a Surge Between Shuttle Car and Belt

The basic function of the feeder is to provide a surge between the shuttle car and belt and permit the shuttle car to discharge its load in a minimum time.

The question may be asked, "Why is this so important?" Shuttle cars have been designed to discharge their loads in 0.25 to 0.50 minutes per shuttle car. The rate varies with the type, size and design of the unit. As an example, a 6SC can discharge 3.5 tons in 0.50 minutes—a rate of seven tpm. This is with no restrictions; however, because of belt loading and jogging the shuttle car conveyor, the discharge rate may be decreased to 2.5 tpm. This is a 180 percent increase in discharge time.

Because of this increase in time to discharge one shuttle car, and when consideration is given to shuttle car wait time, travel from loading machine to dumping point and change-out time, the factors affecting the movement of the shuttle car must be closely examined and analyzed. The time element for discharging a shuttle car without a feeder varies 20 to 40 percent of the total shuttle car cycle time.

A feeder of proper design can reduce the discharge time from 30 to 80 percent depending upon belt size and speed, and the capacity of the shuttle car. The feeder can therefore effect a net reduction in round trip time per shuttle car from six percent of minimum capacity to 32 percent or more for high capacity cars.

Industrial Engineering Analysis

To precisely define the increase in productive capacity that can be expected from a belt feeder, a careful industrial engineering analysis must be made of a specific application of mobile equipment and shuttle cars.

As an example, and very conservatively, if the 3.5-ton shuttle car discharge rate increases from 0.50 to 1.00 minute per shuttle car, and a section normally produces 200 shuttle

cars of material, the additional 0.50 minute increase in discharge rate indicates the loss of a potential 100 minutes available for work. With a properly balanced face cycle, the additional 100 minutes could mean approximately 100 more tons of coal for that section. This example clearly indicates the need for examining very closely the repetitive items of any face cycle that can be responsible for a loss in tonnage.

A complete analysis of an integrated mobile loading unit has a definite measurable capacity. This capacity is based on the standard time required to produce one cut of coal in the mining conditions to which the specific mobile loading equipment is applied. The capacity changes from day to day, because it varies with shuttle car haul distance. Seam height is also critical because it determines the tonnage produced per cut.

When a complete study is made of the capacity of each piece of mining machinery and a man-machine chart is laid out for the integrated mobile loading unit, a specific application of a new piece of equipment, such as the Ratio-Feeder, sets in motion a new chain reaction that again materially affects the complete face cycle. A new study is then made and the effects of the belt feeder can be determined on the new capacity. This new capacity can be converted to tons and additional tons can be converted to cost reduction to determine the payback on the installation of the belt feeder.

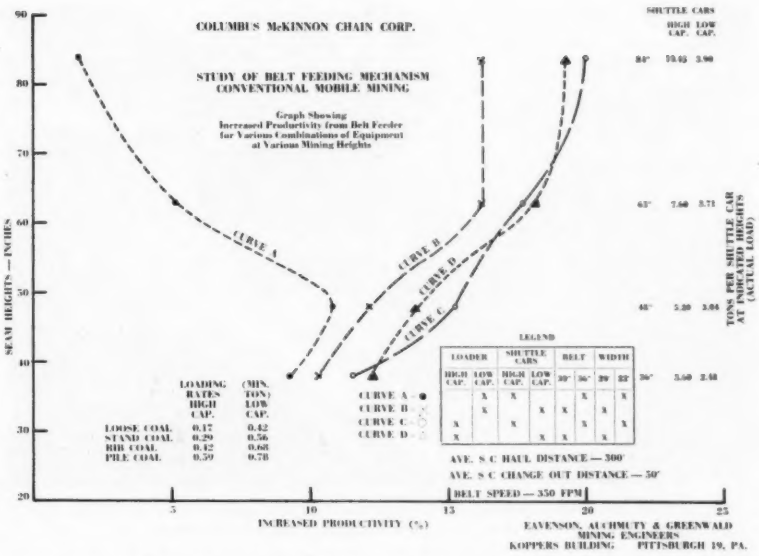


Fig. 2. A graphic analysis of the belt feeder for different combinations of conventional mobile mining and haulage equipment at various mining heights and at a mean shuttle car distance of 300 ft. At this distance, the curves represent the average increase in productivity to be expected

A graphic analysis has been made of the belt feeder for different combinations of conventional mobile mining and haulage equipment at various mining heights and at a mean shuttle car distance of 300 ft. At this distance the curves in figure 2 represent the average increase in productivity to be expected.

The four curves shown, bracket the full range of mining equipment generally used and represent the following combinations of loading machines and shuttle cars.

Curve A	Low capacity loader with high capacity cars
Curve B	Low capacity loader with low capacity cars
Curve C	High capacity loader with high capacity cars
Curve D	High capacity loader with low capacity cars

Points on the curves were deter-

Effect of Feeder on Measured Capacity of Mining Units

Columbus McKinnon, through its consultants, wanted to know the precise effect of the Ratio-Feeder on the measured capacity of any given conventional mobile mining unit as could be found generally in the coal fields.

Because of the many different types and sizes of loading machines, shuttle cars, and face preparation equipment in use, it was necessary to classify the equipment as follows:

Loading Machines	
High Capacity	8 to 15 tpm
Low Capacity	4 tpm or less
Shuttle Cars	
High Capacity	4.5 to 12 tons
Low Capacity	4.5 tons or less
Face Preparation Equipment	
High Capacity	Universal cutting machines, mobile face drills and roof bolters
Low Capacity	Shortwall cutting machines, hand-held face drills and stopers

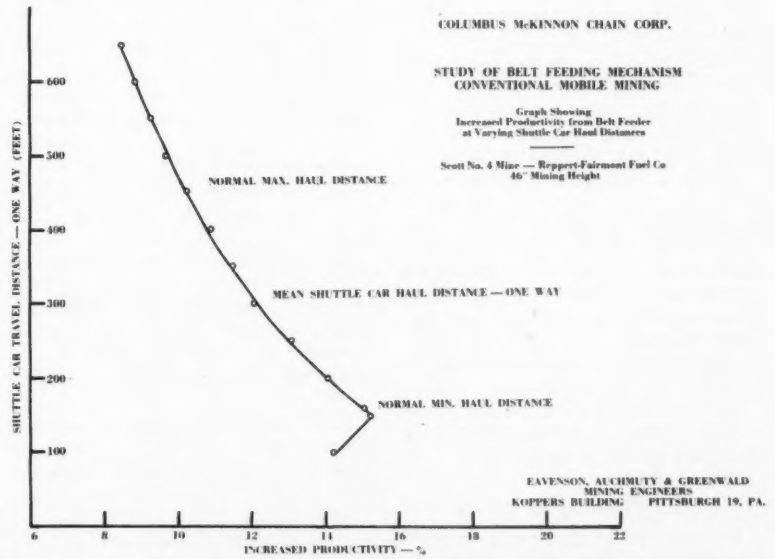

COLUMBUS McKINNON CHAIN CORP.
STUDY OF BELT FEEDING MECHANISM
CONVENTIONAL MOBILE MINING
Graph Showing
Increased Productivity from Belt Feeder
at Varying Shuttle Car Haul Distances
Scott No. 4 Mine — Reppert-Fairmont Fuel Co
46" Mining Height
NORMAL MAX. HAUL DISTANCE
MEAN SHUTTLE CAR HAUL DISTANCE — ONE WAY
NORMAL MIN. HAUL DISTANCE
SHUTTLE CAR TRAVEL DISTANCE — ONE WAY (FEET)
INCREASED PRODUCTIVITY — %
EAVENSON, AUCHMUTY & GREENWALD
MINING ENGINEERS
KOPPERS BUILDING PITTSBURGH 19, PA.

Fig. 3. Graph shows a curve plotted for a specific combination of equipment as applied to a specific mining condition. Note that the greatest increase in productivity due to the use of a belt feeder comes at a minimum haul distance of 150 ft. Reason—this is the shortest haul possible without introducing shuttle car wait time

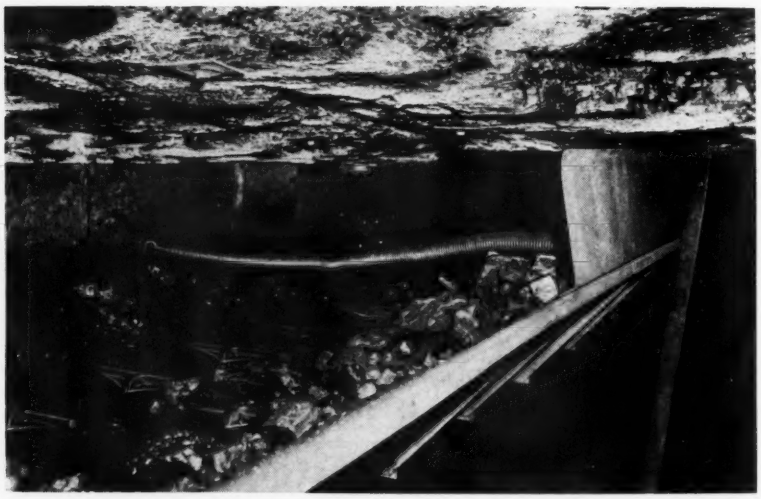


Fig. 4. Jensie Mine uses jack pipes to anchor the 5500-lb feeder. This is to prevent the shuttle car from driving the feeder into the belt structure

mined for mining heights of 36, 48, 63 and 84 in. For each of the seam heights, cycle times were calculated with and without the feeder in use. Note the standard data for loading rates on the graph.

The percentage increase in productivity shown by the graph is only effective for a mining unit in which the capacity is limited by reason of the loading or shuttle car hauling cycle.

In instances where the capacity is limited by other "bottlenecks", such as drilling, shooting and roof bolting, the use of the feeders will not produce the results until these "bottlenecks" are corrected. This again emphasizes the importance and need for close study of all the face cycles.

One question comes up. What happens when the shuttle car haul distance varies from a minimum to a maximum, and what effect does the feeder have on the productivity?

Figure 3 shows a curve plotted for a specific combination of equipment as applied to a specific mining condition. Note that the greatest percent increase in productivity comes at a minimum haul distance of 150 ft. This is because the shuttle car can discharge its full load and return to the loading machine before it starts to wait for the next shuttle car.

Let us now take a look at the feeder as it is applied to the Jensie Mine of The Warner Collieries Co.

Jensie Mine

Located 20 miles northwest of Steubenville, Ohio, at East Springfield, Ohio, Jensie Mine is serviced by the New York Central Railroad and produces approximately 2700 tons of clean, commercially sized coal.

Coal is mined from the Ohio No. 6-A or Lower Kittanning coal seam which ranges from 48 to 54 in. in thickness. The immediate bottom is fireclay, and the roof above the coal is strong sandy shale and is normally good.

Method of Mining

Eight main entries are driven on 50-ft centers and are not to exceed 18 ft in width. Breakthroughs are driven on a maximum 60-ft center. A 400-ft barrier is left on each side of the No. 1 and No. 8 entry. The purpose for leaving the wide barrier is three-fold: (a) provide additional airway capacity if needed over the life of the mine, (b) provide sufficient working area for mechanical units when main barriers are finally retreated and (c) provide sufficient protection for the eight main entries. All entries are roof bolted. The No. 1 and No. 8 entries are used for storing bottoms that are taken in the No. 5 or track entry.

The main face or panel entries are driven off the main entries on 2900-ft centers. Eight main face entries are driven on 50-ft centers with breakthroughs on a maximum of 60-ft centers. Entry widths are not to exceed 18 ft.

Butt entries are turned off on the left and right side of the panel entries. Five butt entries are driven on 50-ft centers with breakthroughs on 50 ft centers. Entry widths are not to exceed 17 ft. Rooms are on 50-ft centers and room widths are held to 35 ft. The maximum room depth is 200 feet from the center line of the outside or No. 1 and No. 5 entry. Butt entry lengths are projected for a maximum depth of 1150 ft.

Various mine projections were carefully studied by the company's industrial engineering department. The problem given to this department was to determine the most efficient projection that can be designed to give the lowest shuttle car wait time, minimum equipment tram distance, maximum coal recovery without disturbing the roof equilibrium, and producing the greatest amount of coal with present face equipment and still keeping in mind whether this projection would be satisfactory if face equipment changes were made. The mine projections outlined represent the results of this study.

At this point, the great need for properly evaluating mine projections should be emphasized. In many mines, projections are sadly neglected because mine managers are content with projections that have been in use since their first installation of mechanical loading equipment.

Haulage

Coal is loaded at the face by conventional loading machines into shuttle cars and then transported and dumped onto 30-in. belt conveyors. Only one section is equipped with a shuttle car belt feeder. The belt conveyors discharge the coal into 7.0-ton, 8-wheel mine cars.

The coal is transported over 60-lb track to a rotary dump at the slope bottom.

Supplies are also handled over the track haulage and transported into the butt entries over 30-lb track laid on steel ties.

Each section has its own Jeep and man-trip car to haul men.

Equipment

The face equipment used on each section is as follows:*

2 14 BU Joy
3 6 SC Shuttle Cars
1 11 RU Cutting Machine
1 CD-26 Drill
1 Fletcher Roof Bolting Machine
1 30-in. Goodman belt

* One section is equipped with a belt feeder.

Face crews consist of the following men:

2 Joy operators
3 Shuttle car operators
1 Cutting machine operator
1 Cutting machine helper
2 Drillers
1 Shotfirer
1 Bolter
1 Utility
1 Mechanic
1 Section foreman

Cycle Analysis Points Up Need for Feeder

For five years the company's industrial engineers recognized the need for a feeder designed to take a full shuttle car load and discharge the same coal onto a 30-in. belt conveyor.

Time studies revealed many times the fact that the loader was waiting on the shuttle cars to return. Even after projections were changed, this loader wait time was still a major problem.

As an example of how costly "loader wait" time can be, a working section in Jensie Mine using two 14 BU Joys and three 6 SC cars has a potential productive capacity of approximately 12 room cuts per shift. With a shuttle car wait time of 3.63 minutes per place, a total of 43.56 minutes is lost. This is for an average shuttle car haul distance of 200 ft. If only one-half of the 43.56 minutes is salvaged or utilized, approximately 40 more tons of coal can be mined. With a crew of 12 men, this is more than three tons per man at the face. With this analysis the company was certain that it was important to find a proper feeder.

Further time studies were made to improve shuttle car discharge time. Studies indicated a 6 SC shuttle car (3.46 tons) could be dumped onto a 30-in. belt in 1.19 minutes. Again it was realized this time could be improved considerably by having a proper link between the shuttle car and belt. A feeder was the answer.

In late 1958 it was determined a new feeder would be tried in several mines. Arrangements were made to study this feeder and in January 1959, arrangements were made with the manufacturer to install a feeder on a trial basis.

Time Study Analysis of New CF-2 Feeder

As soon as the new feeder was placed in service in 8 West section of Jensie Mine, time studies were immediately made. The capacity of the unit was determined. Studies immediately revealed the company could pick up a minimum 6.5 percent increase in tons while advancing butt entries and 6.4 percent increase in tons could be expected in retreating rooms in a butt entry. Initial savings indicated a payback in three months on the feeder investment. This was worth considerable more investigation and attention.

As mentioned earlier, a thorough study of mine projections was instituted.

The following chart was setup showing the various raw ton capacities for various combinations of loading and using various changes in projections.

Under Item 5 above, the 27.5 percent increase is predicated on using a new design feeder with seven ton capacity. This will permit the mine to dump its Torkars at full capacity of the discharge conveyor.

Large Capacity Shuttle Cars

On February 2, 1959, two new six-ton Torkars were installed on the 8 West section of Jensie Mine.

The company was not sure what the effect of high capacity shuttle cars would have on the low capacity CF-2 feeder, which was originally designed for three-ton loads.

Jensie's operating men, being typical and possessing that inquisitive trait so common around mines, decided to dump the six-ton load onto the three-ton feeder. Surprisingly, it was discovered this feeder would take the load in approximately one minute. However, at times the shuttle cars dumped in 0.50 minutes. This is 12 tpm.

Because of the heavy six-ton shuttle car load and the small relative capacity of the feeder, some maintenance difficulties were experienced with the feeder.

The manufacturer is now building a new Model RF-57 seven-ton capacity feeder. This unit is designed to take six-ton shuttle car loads and will immediately eliminate the maintenance troubles.

By comparing theoretical capacities of using a 14 BU Joy and loading into 6SC shuttle cars and Torkars, a 14 percent increase in capacity was shown with feeder unloading facilities. From actual time studies management proved a 13 percent increase in performance on the same section.

Description of Model CF-2

The CF-2 is 23 ft long, 30 in. wide at the throat or discharge end of the feeder, and 8 ft 6 in. wide at the shuttle car loading end. Height at the discharge and loading end is 32 and 27 in. respectively. The unit weighs 5500 lb.

Feeder is powered by a ten-hp motor. The motor is connected through a V-belt drive arrangement to a shaft mounted Dodge speed reducer and the output shaft is connected to head sprocket for driving the chain. Chain speeds on this unit can be varied from 70 to 90 fpm. This can be done electrically through rheostat adjustment and further changes can be made by changing the V-belt pulley arrangement.

A case hardened alloy link chain is used. Flights are high strength ductile iron attached to the link chain through a cotter key connection.

Practical Operating Problems

With the installation of any new piece of machinery, experience dictates a course of action for the best and most efficient performance. Some of the things the company has learned about this feeder are:

1. Maintain sufficient clearance at discharge and loading end. If seam height is a factor, brushing a little bottom or top will be advantageous.
2. Eliminate "raise boom" time on shuttle car. This is a highly repetitive element and if it is necessary to raise the shuttle car boom, much of the advantages of the feeder will be lost.
3. Moving the CF-2 feeder can be accomplished by hooking a loader to it and dragging it into position. This can be done in less than 30 minutes in entry work and in room work will require more time because it will be necessary to drag the unit around one or more of the entry chain pillars.
4. Feeder should be anchored to prevent the shuttle car from driving the feeder into the belt structure. Jensie Mine uses jack pipes.
5. Moving from one section to another is speeded up because sideboards can be dismantled and laid in bottom of the conveyor for ease of movement.

Other Advantages of a Feeder

The writer has emphasized the importance of reducing shuttle car dis-

Projection	Entry & Room Ctrs. Ft	Entry Breakthru Ctrs. Ft	Shuttle Car Haul Dist.	Size of Belt In.	Feeder	Loading Equipment	Capacity Raw Tons	Percent Increase
1—5 entries	50	50	200	30	No	1 14BU; 2 6SC	483	
5 entries	50	50	200	30	Yes	1 14BU; 2 6SC	528	9.1
2—6 entries	50	50	200	30	No	1 14BU; 2 6SC	478	
6 entries	50	50	200	30	Yes	1 14BU; 2 6SC	528	10.2
3—5 rooms	50	50	280	30	No	1 14BU; 2 6SC	469	
5 rooms	50	50	280	30	Yes	1 14BU; 2 6SC	510	10.9
4—8 entries	50	60	200	30	No	1 14BU; 2 6SC	449	
8 entries	50	60	200	30	Yes	1 14BU; 2 6SC	504	12.2
5—5 rooms	50	50	250	30	No	1 14BU; 2 Torkars	510	
5 rooms	50	50	250	30	Yes	1 14BU; 2 Torkars	650	27.5

charge time, and this can only be done by permitting a shuttle car to discharge its full load at a maximum rate. By doing this the loader wait time is reduced, and a resulting increase in productivity can be expected. In many cases this increased productivity will justify the purchase of a feeder.

However, there are other advantages which need to be closely analyzed by each mine operator to determine the need for a shuttle car belt feeder.

These are:

1. Increased hauling capacity from present belt conveyors.
2. Many mines are changing to larger belts. A proper analysis of feeder applications for present face equipment may change plans to purchase larger belt conveyors.
3. Belt speed can be decreased to carry same output. This in turn can change belt specifications and reduce cost per foot of belt.
4. Belt maintenance costs can be reduced by proper loading of material on belt lines.
5. Belt damage from scuffing and abrasion due to spillage along belt lines is eliminated.
6. Belt spillage clean-up costs can be reduced.
7. Construction of ramps can be eliminated, and in many cases brushing of roof or bottom can be eliminated.
8. Shuttle car maintenance costs can be reduced by elimination of "jogging" of shuttle car conveyor.
9. The need for elevating discharge booms on shuttle car conveyors can be eliminated with a resultant decrease in shuttle car cost.
10. Better performance at transfer points and mine car loading stations is possible because of uniform feeding of material.

Undoubtedly there are many more advantages not listed here.

10-15 Percent Increase in Productivity on Shuttle Car Sections

In every coal mine, because of the highly competitive product, there is a need for continued and dedicated study and analysis to improve productivity. The industry has become highly mechanized and has doubled its productivity in the last 20 years.

The industrial engineering analysis of coal's problems is no longer the unwanted child. It has developed into a useful tool for mine operators. It can also be a very effective tool in assisting manufacturers to design mine equipment in which there is no guesswork, trial and error as has been common in the past. Once a problem is recognized, a machine or piece of equipment can be designed to solve that problem. However, careful analysis is needed to determine how other cycles are affected by additions of new equipment.

The feeder described is the result of this type engineering and design. It has a place in the industry's productive units and the 10 to 15 percent increase in productivity on shuttle car sections is realistic and practical. So why not attain this goal!

BERKELEY PIT OPERATION

(*Continued from page 54*)

Mining Operations in the Berkeley Pit

With the above facilities, the Berkeley pit is producing 26,000 tpd of ore, five days a week. The copper content, through blending, averages the grade calculated for the entire pit.

Drilling: Blast holes, all of which are sampled, are drilled with one Joy 225 truck-mounted rotary drill and three Bucyrus-Erie 40-R track-mounted rotary drills. The diameters of holes are 6¼ and 9 in., respectively. The average footage drilled in an eight-hour shift is 604 ft for the Joy drill and 521 ft for the 40-R's. The average cost per ft of hole drilled is $0.2536.

Hole spacing varies in the different types of ground in the pit; 21-ft toe and 21-ft spread in hard ground to 20-ft toe and 30-ft spread in soft ground. All holes are drilled seven ft below bench grade.

Blasting: An ammonium nitrate-diesel oil mixture is used for the explosive, and is detonated with three and five-lb nitrimite primers. The trunk line, connected to a single line of detonating cord down the hole, with millisecond delays between holes, is fired with a number 6 electric cap. The most explosives used for any one shot has been 3200 lb. Amount used in each hole, depending on ground conditions, varies from 240 to a maximum of 400 lb.

The material broken varies from 4.22 to 6.23 tons per lb of powder, averaging 5.35 tons.

The six-month average cost to break one ton of material is $0.0177. Secondary blasting is nil.

Loading: All the work in waste and ore is being done with 150 B Bucyrus-Erie six-yd electric shovels which load into trucks on both sides of the shovel. Tractor units are used at each shovel for clean-up.

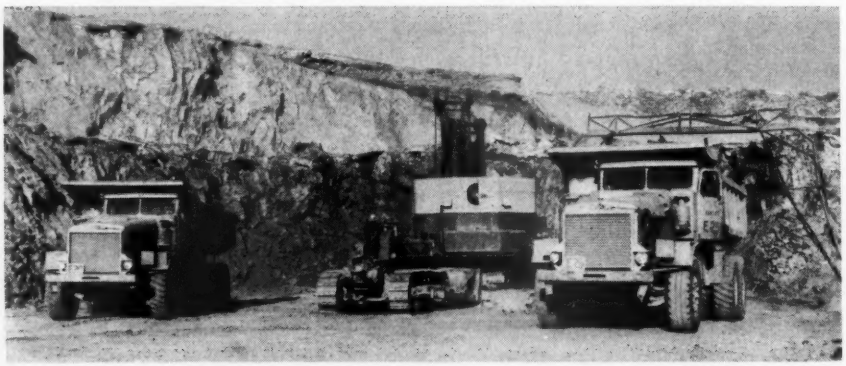
All shovels average 6710 tons per eight-hour shift, some shifts in waste going as high as 10,000 plus tons per shift.

Cost of loading, six month average, is $0.024 per ton of material moved.

Hauling: In the removal of broken material from the pit, 34-ton diesel powered trucks are used, averaging 36 plus tons per trip and 1008 tons per eight-hour shift. Haulage distances vary from 3000 to 13,000 ft.

Trucking cost, six-month average, is $0.098 per ton which includes $0.021 per ton tire cost.

Availability of trucks averages 84 percent. Out-time includes fueling, greasing, etc. Repairs to trucks average $0.0285.



Loading and hauling are done with six-yd electric shovels and 36-ton capacity trucks. All shovels average 6710 tons per eight-hour shift with some shifts in waste going as high as 10,000 tons. Haulage distances vary from 3000 to 13,000 ft

Nuclear Energy and the FUTURE

Exceptional progress has been made in the control of fission reactions, but scientists have only scratched the surface in exploiting the extreme temperatures and energy concentrations available. Fusion reactions are even more difficult to control, and progress in this field is in the very early stages of development. Nevertheless, all signs point to the fact that it is not a question as to "whether" we shall use nuclear power extensively, but merely "when"

By

R. D. BENNETT

Manager, Vallecitos Atomic Laboratory
General Electric Co.

THIS article concerns the present state of the art of extracting energy from uranium; it indicates some of the directions our efforts are taking to improve present processes for getting the energy more economically, and it discusses what we are doing to extend the application of nuclear energy to new fields.

First, let us review the kind of process with which we are dealing, in order that you may more easily see why we think nuclear energy has such great possibilities for the future.

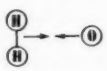
Ratio of Energies 79,000,000 to 1

We began to have some knowledge and control of chemical reactions more than a hundred years ago. Steady extension and application of this knowledge has given us new substances and better energy sources. Then, in 1939, an entirely new kind of process was discovered, whereby it became possible to release the energy of the nucleus.

Figure 1 compares the chemical and fission processes. The chemical reaction the author has selected is that of hydrogen burning in oxygen, which is one of the more energetic of the common reactions. Beside the sketch indicating this reaction is an indication of what happens when a slow neutron fissions a uranium-235 nucleus. The energies of the two reactions, in terms familiar to the physicist, chemist, and engineer are tabulated beneath each sketch. Whatever the units used, note that the energy ratio comes out about 79,000,000 to 1, which is a measure of the enormous energy concentration we can get from the fission process. This is why fission has such profound implications with respect to our ability to control the forces of nature and the environment around us.

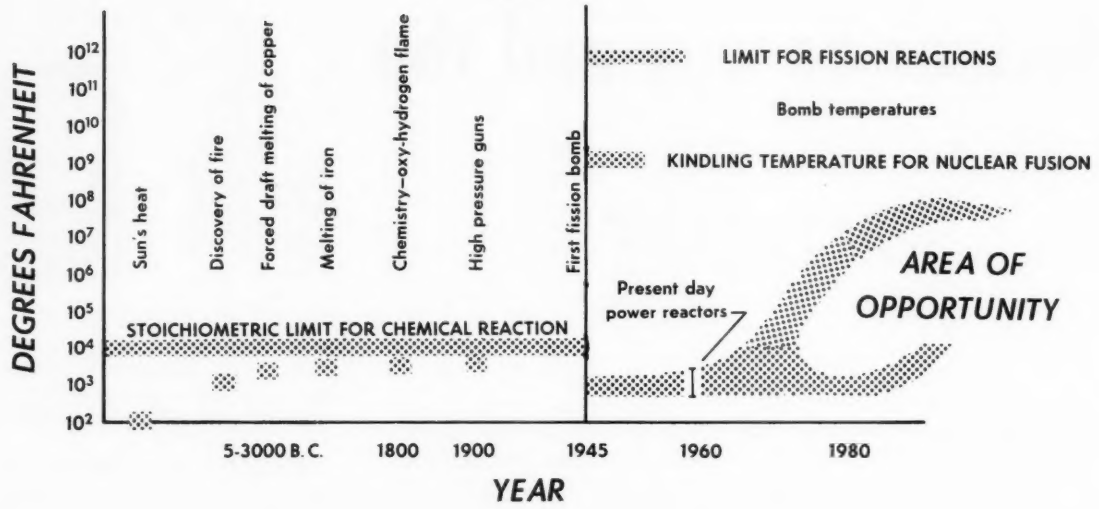
Another way of showing the dramatic change in energy outlook is illustrated in figure 2, which shows roughly the temperatures we have achieved in our efforts to release and control power. The time scale is both arbitrary and elastic. The left half of the diagram indicates our slow approach to the limit set by stoichiometric chemical reactions at around 10,000°F. The discovery of fission in 1939 released us from this temperature limitation. Note that the

Figure 1

CHEMICAL REACTION	FISSION REACTION
	
BURNING OF HYDROGEN IN OXYGEN	FISSION OF U_{235} BY A SLOW NEUTRON
THERMAL ENERGY RELEASE	KINETIC ENERGY RELEASE
2.53 electron volts per molecule 29,000 calories per gram 52,000 Btu per pound	200,000,000 electron volts per atom 1.95×10^{10} calories per gram 3.5×10^{10} Btu per pound

$$\text{Ratio} \quad \frac{\text{FISSION}}{\text{COMBUSTION}} = \frac{79{,}000{,}000}{1}$$

Figure 2



scale of ordinates is logarithmic, and with the firing of the first bomb, we raised the limit of available temperatures by about eight orders of magnitude in one abrupt step. This gave us a whole new world of energy, power and temperature.

The first application of fission energy came as the bomb, involving a reaction which, once started, is essentially uncontrolled. The reaction proceeds at very high temperature and high efficiency. A large fraction of the available fuel is consumed in a very short time, with a release of energy and a power beyond anything we had previously approached.

The high temperature produced by fission was soon used to kindle the fusion reaction, which synthesized light atoms into heavier ones, with an even more enormous release of energy and power.

Fission Reactions Not Yet Fully Exploited

However, if we look at where we stand in exploiting the fission reaction to provide energy to run conventional power plants, as indicated in figure 2, we see that we have not yet gone very far into the area of opportunity, exploiting either the temperatures or the energy concentrations available.

We have, however, made significant steps forward. Experience with boiling reactors has shown that neither radioactivity carry-over in the steam, nor instability caused by boiling in the core is likely to be a problem. We can, therefore, expect these lighter, simpler systems to be adopted rapidly.

The first attempt to improve steam conditions to levels approaching those of modern practice was embodied in the submarine SEAWOLF. Although superheater technology had not advanced to the level required to provide superheaters that would stand up, the sodium-cooled reactor has performed well and reliably, indicating that this system can be made to work successfully, and that superheated steam can be obtained by its use.

Much interest is now centered about using a gas-cooled reactor to superheat steam furnished by a conventional boiling reactor. This interest can be counted on to lead to such a device in the fairly near future, drawing on technologies already highly advanced, both here and abroad.

Another area in which there is much opportunity for improvement is in higher burn up of fuel. This can be accomplished either by making more durable fuel elements, or by reducing the cost of fabrication, or by simplifying the reprocessing procedure. Progress is being made in all these areas. Furthermore, standardization of fuel elements will come in time, with the resulting economies of mass production methods.

Another improvement we can expect is less elaborate cladding procedures, and less expensive cladding materials, with work going forward rapidly in both areas. While the ultimate objective of shoveling uranium oxide into the firebox looks difficult to attain, we undoubtedly will come much closer to it than we are at present.

Higher Temperatures Are Key to Progress

It is of interest to speculate further with regard to the area of opportunity indicated in figure 2, bounded in one dimension by an astronomical temperature scale, and the other by the years of the next decade or two. The key to progress seems to be higher temperatures. It is obvious that we need go only a little way up the scale toward bomb temperatures before the efficiency limitations of the Carnot cycle cease to be a handicap.

We can expect a steady improvement of materials. These improvements are being stimulated by the demands of jet engines, and more recently, by those of reactors being built to heat the working fluid of rockets.

The success we are having getting nose cones back through the atmosphere, using ablation, and other processes to enable them to withstand temperatures far beyond previous experience, indicate an approach at least to short-lived engines of high temperature, efficiency and power.

With the powers we now visualize, the conventional methods of heat transfer become inadequate to the task. Two new approaches offer themselves, namely the generation of the heat in the working fluid itself, which has many advantages for high power operation, or the transfer of heat by radiation, which knows no limitation if we can learn how to use it.

Another way of looking at our present position is illustrated in figure 3, wherein our known technology is portrayed in relation to a scale of duration of the fission reaction. We seem to have the situation under fairly good control at the bottom of the scale for fission (and also fusion) bombs, where the reaction is sustained for a microsecond or so. At least there seem to be lots of bombs of all sizes, and apparently most of them work. They seem to be characterized by fairly efficient use of fuel, very high temperatures, and good mechanical efficiency.

At the top of the scale, we have our power reactors, designed to run weeks without interruption and years

One of GE's test reactors

without refueling. They have low burn up of fuel, low temperatures, and low efficiency.

In between there is an energetic effort, stimulated by the interest in space travel, to build engines which will deliver power of the order of thousands of megawatts for periods of hundreds or thousands of seconds for rocket take-off.

There is a further interest in long-duration power supplies of very light weight for space ships, to provide power for long-term, low-thrust ion drives, as well as for communication and other auxiliaries.

A recent proposal visualizes a sufficiently steady flow of power for rocket take-off and drive, using small atomic bombs for propulsion. While the idea is at first startling, by the proper use of elastic and inertia devices, the passenger might suffer a ride not much more uncomfortable than that provided by the one-cylinder motor car of 1905. This approach has the advantage of high burn up, high temperatures, and high thermal efficiency.

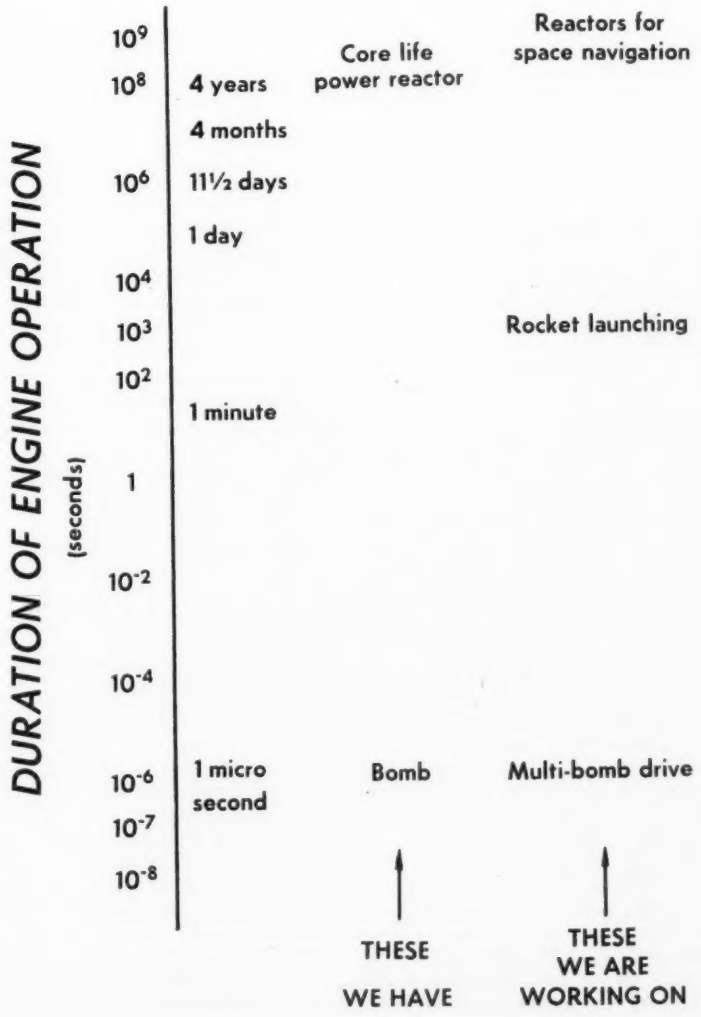
Nor is space travel the only possibility a free ranging imagination can conceive as being made possible by fission energy. We now begin to have available quantities of energy that might be adequate to serve as triggers for elementary controls of the weather. Perhaps uranium energy will be adequate to solve the salt water rectification problem in time to meet the ever-increasing demand for fresh water.

Getting closer to our every day problems, it is perhaps worth noting that we build about a billion horsepower of automotive engines a year, which represents a power market far larger than that of the current utility industry—a market which sometime, somehow, may have to be powered directly or indirectly by uranium.

Still closer is the ever-increasing per capita demand for electric power as now used, plus an explosive population increase nearly everywhere, plus an ever-higher pressure for industrialization, and hence power, in the remaining non-industrial countries.

The question seems not to be whether we shall use nuclear power extensively, but merely "when." General Electric Company feels that the time is soon. Installations in San Jose and at Vallecitos are prepared to exploit each break-through, large or small, toward reducing the cost, increasing the availability and extending the application of nuclear power. Company plans call for a very extensive use of such power at economical levels within the next fifteen years.

Figure 3



Recent Applications of Wire Line Coring

A new method for pulling cores promises to improve core recovery and reduce coal exploration costs in the same way that it has in other branches of the mineral industry

By

M. J. GLEASON
Manager, Contract Drilling Division
E. J. Longyear Co.

BASICALLY, the wire line coring technique differs from the conventional coring method in that a retractable inner tube is used. At the end of each core run, the core-laden inner tube assembly is hoisted to the surface through the drill string, as opposed to the conventional method wherein it is necessary to pull the entire drill string and core barrel in order to recover the core.

Before 1955, conventional ball-bearing, swivel-type core barrels were used almost exclusively on coal coring operations in the United States and in many foreign countries. In the early summer of 1955, E. J. Longyear Co., in an effort to effect higher core recovery, speed up drilling progress, and combat rising labor and material costs, placed in service on a drilling project located in the western Kentucky coal field, a string of NX-size wire line coring tools.

During the preceding two year period, both the NX and smaller diameter BX-size wire line core barrel and associated accessory tools had been applied with outstanding success on coring operations in the southwest copper and uranium districts; in midwest sediments bearing gypsum and fluorspar deposits; in Lake Superior Pre-Cambrian rocks containing copper, nickel and iron ore; in the Appalachians in both sedimentary and crystalline rocks, exploring for uranium, lead, zinc, lithium, and non-metallics; and in the western altered volcanic rocks, in a search for precious metals. Both angle and vertical holes had been completed to depths ranging from 300 to 4700 ft. The initial test in the coal fields was successful, and subsequently wire line tools and coring techniques have been successfully employed in other coal districts in the United States and in Europe, South America and Asia.

Problems in Perfecting Small Diameter Tools

Application of the wire line coring principle is not new. The petroleum industry developed the basic equipment and drilling procedure many years ago. However, the tools employed were of large diameter, often ranging up to eight in. in size, and it was not until after a six year period of continuous testing and development work that E. J. Longyear succeeded in perfecting small diameter tools such as the NX-size equipment used initially on the above-mentioned coal program in Kentucky. Some of the more difficult problems which had to be overcome by the field technicians and mechanical engineers in perfecting these tools were:

1. Development of a positive inner tube latching mechanism;
2. Development of a drill string which would provide the desired internal clearance required for entry of the inner tube, and at the same time withstand torsion, tensile, compressive and shock stresses developed in holes ranging from 4000 to 5000 ft in depth;
3. Development of simple, inexpensive auxiliary hoisting equipment;
4. Development of techniques and equipment required to operate safely the wire line core barrel in dry holes and also in holes where large quantities of coarse cuttings are present and which must be flushed rapidly from the drill hole to prevent freezing and possible loss of the tools and the drill hole;
5. Development of diamond bits which would give optimum penetration rates and long life;
6. Incorporation of proven principles of coring necessary to obtain maximum core recovery, together with positive acting circulating fluid shutoff valve mechanism.

Technique in Coal Exploration

Normal Operation Procedure Employing Wire Line Tools

The NX wire line core barrel and accessory equipment consists of the following principle assemblies:

1. Diamond bit, 2-31/32 O.D. by 1-9/16 in. I.D.;
2. Reaming shell;
3. Core barrel outer tube assembly;
4. Core barrel inner tube assembly;
5. Overshot assembly, which is attached to the wire line cable used for retrieving the inner tube;
6. String of flush-coupled NX-size drill rods, 2⅜ in. I.D. by 2¾ in. O.D.;
7. Portable high-speed wire line hoist;
8. Optional accessories for difficult drilling conditions;
   a) Locking head with ball check valve;
   b) Circulating fluid stuffing box;
   c) Water shutoff valve;
   d) Dry hole overshot release.

Let us now examine the normal operation procedure employing wire line tools.

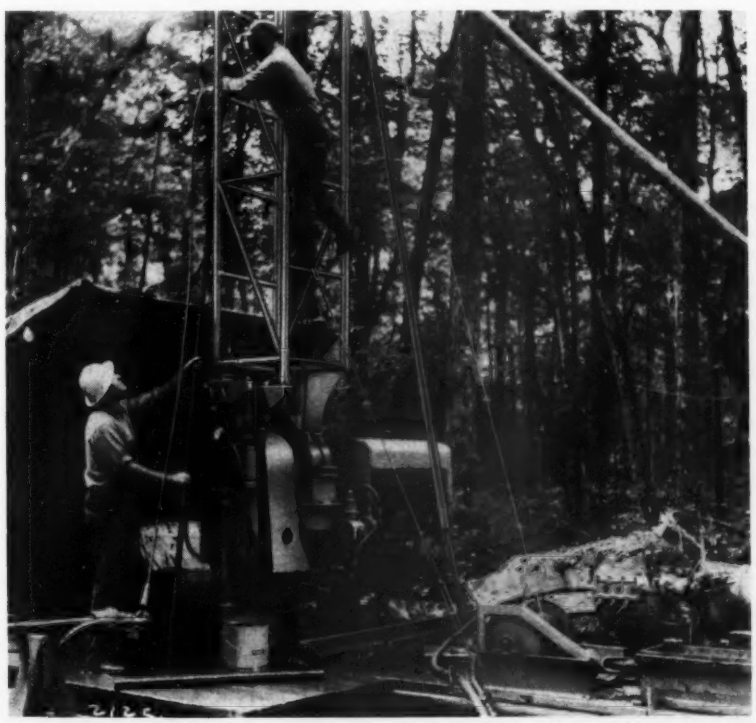
Either after the completion of a normal core run or an indication of a core block, the entire drill string is hoisted until the uppermost drill rod joint is located either slightly above the foot clamp, or the swivel head of the drill, depending upon equipment and drilling practice being used.

The hole is then flushed or circulation is maintained as required.

After removal of the top drill rod section, the overshot assembly is lowered through the drill stem to engage the spear of the inner tube assembly. The inner tube is then hoisted to the surface and removed from the overshot.

A second inner tube assembly, which has already been serviced and inspected, is immediately dropped or lowered into the drill stem on a wire line cable in the case of a dry hole, or permitted to drop freely through the drill rods if the fluid level in the hole is a hundred feet or less below the collar of the drill hole. The rate of descent of the inner tube in a water-filled, vertical hole is approximately 200 fpm and, in holes having a total depth of 700 ft or more, it is the practice to pump the inner tube into position. In addition to accelerating the downward descent of the assembly, this procedure also permits the operator to determine the exact time the inner tube makes contact with the landing shoulder of the outer tube, and is a signal to him that the drilling operation can then be resumed. In holes of shallower depths in which the pumping method is not used, the operator places his hand on the drill stem and waits until the vibration produced by the inner tube making contact with the landing shoulder is felt before resuming drilling.

A water shutoff valve, which is located above the ball bearings in the inner tube head assembly, is employed to prevent the grinding of core, increase core recovery, and reduce diamond bit costs and excessive wear on the inner tube assembly. In instances where core blocks occur in the inner tube, the resultant upward thrust produced on the inner tube causes the shutoff washer to expand and results in a sharp increase in the fluid pressure. This indicates to the drill operator that a core block has developed and that further drilling would cause grinding of core and



In this wire line operation, the retractable inner tube of the wire line core barrel has just been hoisted to the surface through the drill string. The man on the mast is disconnecting the overshot, a latching device which is lowered on the wire line cable to release and raise the inner tube and the core it contains

might result in destruction of the bit due to an inadequate water supply.

For further details of construction of the core barrel and overshot assembly, see the accompanying sketch and photograph.

Improved Core Recovery and Savings in Time and Costs

The main advantages gained through the use of the wire line coring technique include the fact that the diamond bit, outer tube of core barrel, and drill stem can be left in the hole until the bit has become unserviceable, or until the hole must be stabilized through the use of casing or cement. This eliminates much of the time normally utilized in handling conventional tools and results in a proportionate increase in net drilling time.

In drilling holes with conventional equipment through shale, sandstone, and other similar materials which are often weak and poorly consolidated, these materials are frequently ruptured or broken down by the hydraulic pressure which is set up by the drill stem and core barrel as it is lowered into the hole. This piston effect often results in the complete breakdown of the hole, and makes it necessary to suspend drilling operations until the hole can be satisfactorily stabilized by either casing or cementing.

In wire line coring operations, wherein the drill string remains on the bottom of the hole for relatively long periods of time, the attrition of the weaker strata exposed in the drill hole is minimized. Also, since the bit remains near the bottom of the hole between core runs, drilling over cave which has spalled from the wall of the hole is eliminated. This results in increased shell and bit life and reduces the danger of premature blocking which often occurs when drilling over foreign material or cave.

Due to the sturdy construction of the core barrel, its life is normally much greater than that of a conventional core barrel, with the result that a substantial saving is realized in core barrel costs especially when drilling in highly abrasive formations.

Although it is recognized that the design of the wire line core barrel is more intricate than that of the conventional core barrel, experience indicates that an experienced diamond core driller can be properly trained to operate the equipment in a matter of a few shifts. Because the wire line tools require much less effort to operate than conventional equipment, it is never difficult to get the average operator to accept readily the wire line equipment. As an illustration, let us assume that the average diamond bit life on a drilling project is 100 ft. Under these circumstances the wire line drill operator would make only one round trip with the drill stem for each 100 ft of hole cored; whereas it would have been necessary for the driller using conventional equipment to pull and lower the stem at least five times if he were using a 20-ft core barrel.

Because it is possible to pull the inner tube and extract core with a minimum amount of physical effort and time, short core runs in difficult coring ground can be made without increasing the cost beyond economical limits. For example, in blocky ground in 500-ft depth holes, it is not unusual for the operator to pull and lower the inner tube 25 to 30 times during the course of an eight-hour shift.

Drill hole inclination tests can be easily made through the inside of the drill string by lowering and retrieving the clinometer on the wire line. Time studies made in a 3000-ft depth hole show that inclination tests can be completed with the wire line method in a matter of one hour; whereas a minimum of four hours is required when using conventional equipment.

When the drill stem normally used with conventional tools becomes lodged in a drill hole and can not be recovered by pulling and jacking methods, it is usually necessary either to over-ream the complete stem or back it off in order to complete the fishing job. This is usually done as a last resort, and can prove very time consuming and costly. Because of the relatively large internal clearance in the wire line drill stem, it is possible to lower a cutting tool through the stem and cut off the drill string at a point above the top of the core barrel, or at some other point at a higher elevation if desired. This procedure has been used successfully on many occasions.

In addition to these mechanical and time-saving advantages, the two most important benefits from the use of wire line equipment are:

a) Increased core recovery in critical horizons and
b) Reduced diamond costs.

Performance to Date

Western Kentucky. A total of 28,000 ft has been drilled in holes ranging in depths from a minimum of 900 to a maximum of 1700 ft in the Pennsylvania System with NX-size wire line tools. Measured core recovery for the entire cored footage, which included sandstone, shale, limestone in varying amounts, in addition to coal, has been 99.9 percent with complete recovery in coal at all times, with the exception of one hole in which mechanical trouble resulted in unsatisfactory results. The records indicate that the time consumed in an average 10-ft coring cycle in a 1500-ft depth hole varied from a minimum of 50 minutes to a maximum of 1 hour and 20 minutes, depending upon the rock type being penetrated. A breakdown of the coring cycle at the above mentioned depth interval is as follows:

a) Coring 10 ft—minimum 30 minutes; maximum 1 hour;
b) Breaking rod joint—3 minutes;
c) Lowering overshot—4 minutes;
d) Hoisting core-laden inner tube—5 minutes;
e) Dropping inner tube—8 minutes;
f) Washing out hole—10 minutes.

Total elapsed time—minimum 60 minutes; maximum 1 hour 30 minutes. Although corresponding performance data on conventional tools is not available for this particular project, experience gained elsewhere under comparable conditions indicates that the coring cycle would be approximately as follows:

a) Coring 10 ft—minimum of 20 to maximum of 40 minutes;
b) Washing out hole—15 minutes;
c) Round trip with drill stem, employing 30-ft length pulls—2 hours;

Total elapsed time—minimum 2 hours 35 minutes; maximum 2 hours 55 minutes.

As can be seen from the above tabulations, the time required to complete a ten-ft core cycle with the wire line tools amounted to a maximum of 1 hour and 30 minutes, as compared with a minimum of 2 hours and 35 minutes with conventional tools. This represents a time saving of approximately 65 minutes, or 42 percent for each ten-ft run. Applied to an eight-hour drill shift, and assuming that a maximum length core run of ten ft could be achieved on each trip into the hole, a total of 53.3 ft would be drilled by wire line during actual drilling time (exclusive of moving, rigging, and other non-productive time) as compared with a total of 31 ft with conventional equipment. Obviously, if shorter core runs were necessary to insure maximum core recovery, the time saving would be even greater when using wire line equipment.

Midwest. During the past three year period a major coal company, who has operations in Illinois and Indiana, has successfully employed NX wire line on holes varying in depth from a minimum of 60 ft to a maximum of 450 ft. This company reports that average progress, including breakdown time, move up time, and other non-productive work, normally runs 100 ft per 8-hour shift. The core recovery through sediments, fire clay, and coal approaches 100 percent at all times. Drillers prefer wire line, especially in the holes which require coring of several seams of coal or coring of extended lengths.

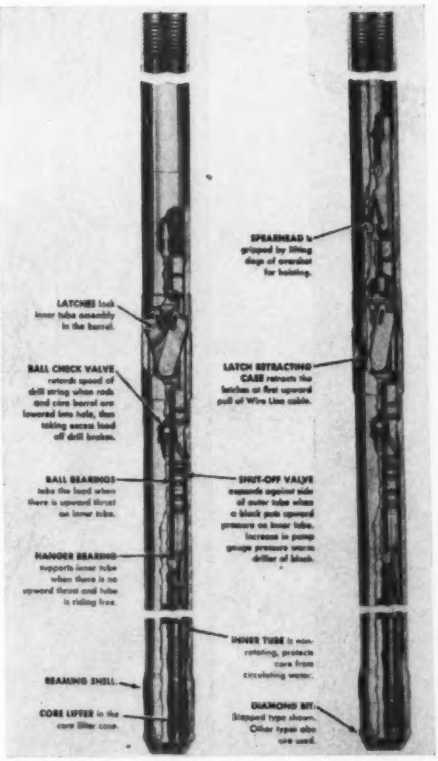
Venezuela. In an eight month period extending from September 1957 through April 1958, a drilling contractor operating in eastern Venezuela employed NX-size wire line tools for drilling core holes to a maximum depth of 1500 ft. Average core recovery through coal seams penetrated was 97 percent. Due to the friable nature of both the coal and the associated formations, the core runs seldom exceeded two ft in length. The contractor reported that it would not have been possible to drill these holes and achieve comparable core recovery with conventional equipment due to the cost limitation.

Kogayama Program — Japan. During the past year the Mitsubishi Coal Mining Co. of Tokvo employed NX wire line tools for deepening a coal exploration hole which had been drilled to a depth of 656 ft with conventional equipment. This hole was advanced to a total depth of 1692 ft by wire line method. While it is felt that insufficient footage was drilled on this program to permit a true evaluation of the relative merits of the two methods used, it should be noted that the over-all core recovery achieved with wire line tools amounted to 97.88 percent as compared to 65.5 percent with conventional tools.

France. Since early in 1957 the NX-size tools have been successfully employed on 1700-ft depth holes in France. Core recovered through coal seams has been very satisfactory, and the drilling progress with the wire line equipment has been almost 50 percent better than that achieved with conventional tools.

Tools Being Designed To Recover Larger Diameter Cores

It is believed that all of the work accomplished to date in the coal industry with wire line tools, at least that performed in the United States, has been exploratory in nature, and has been done with NX-size equipment which produces a 1-9/16-in. diameter core. It is recognized that cores of this dimension are not considered adequate by certain companies for metallurgical and other laboratory tests that are standard in the industry today. In an effort to overcome this deficiency, E. J. Longyear is in the process of designing a string of new wire line tools which will produce cores comparable in size to those recovered with standard equipment.


SPEARHEAD is gripped by lifting dogs of overshot for hoisting.
LATCHES lock inner tube assembly in the barrel.
BALL CHECK VALVE retards speed of drill string when rods and core barrel are lowered into hole, then taking excess load off drill blocks.
LATCH RETRACTING CAGE retracts the latches at first upward pull of Wire Line cable.
BALL BEARINGS take the load when there is upward thrust on inner tube.
SHUT-OFF VALVE responds against side of outer tube when a block puts upward pressure on inner tube. Increase in pump gauge pressure warns driller of block.
HANGER BEARING supports inner tube when there is no upward thrust and tube is riding free.
INNER TUBE is non-rotating, protects core from circulating water.
REAMING SHELL
CORE LIFTER in the core lifter case.
DIAMOND BIT. Stepped type shown. Other types also are used.

Construction of the wire line core barrel and overshot assembly. Increased core recovery in critical horizons and reduced diamond costs are two advantages claimed for the equipment

In view of the improved core recovery and the substantial savings which can be realized in both time and drilling costs employing the wire line method, it is the opinion of the writer that it will be only a matter of time until wire line tools will become standard equipment in the coal industry, just as they have in many other branches of the mineral industry. This may mean the acceptance by the coal industry of a smaller diameter core than is presently used, or possibly the development of an entirely new set of larger tools such as those now being designed by E. J. Longyear Co. In any event, this project will require the full cooperation of all concerned in order to be successful.

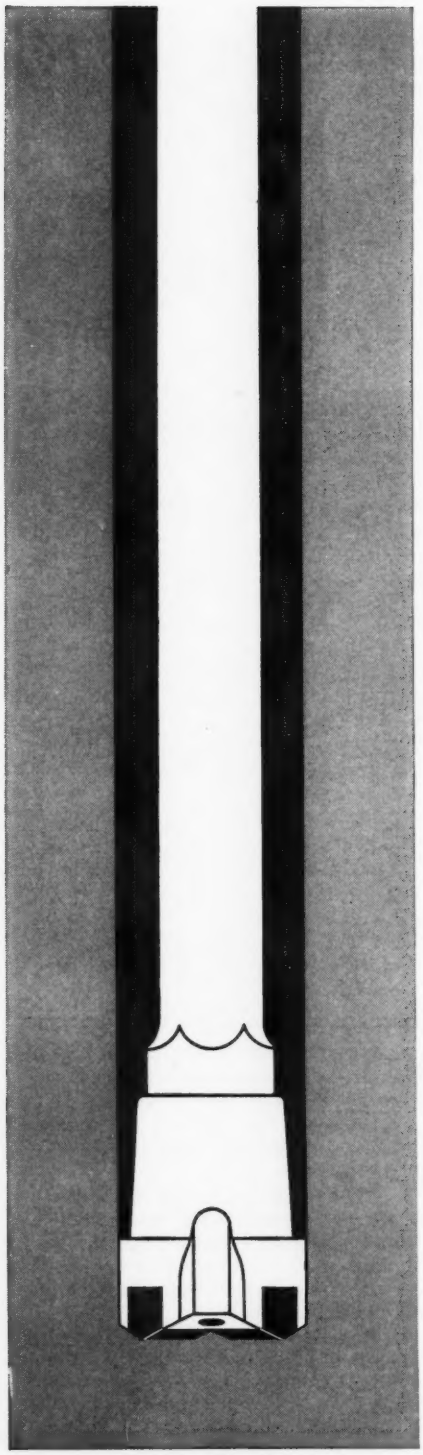
SUPPLY COST REDUCTION

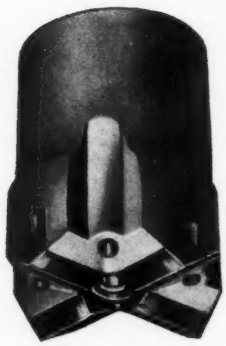
(*Continued from page 40*)

Showing storage locations on shipping orders and packing slips is a simple thing. Yet without it, the filling of orders and binning of parts would require at least a 33 percent increase in man hours needed.

The company's detailed supply cost reports are relatively new. They have, however, provided management with a foundation upon which it is building a cost-reduction program. Costs can be analyzed from the total right down to individual items regardless of classification. Not only do these reports make fixing of cost responsibility possible, but they disclose where action is necessary to stay within objectives. Such action could include such things as elimination of waste, development of better methods, improvement of maintenance techniques, requests to suppliers and manufacturers for better materials, dissemination of pertinent information, etc. Action taken already has resulted in definite improvements on certain individual items and the pace seems to be accelerating.

This article has tried to show some of the benefits which have accrued to Pocahontas Fuel through the application of IBM machines to supply cost control. However, the author does not intend to imply that this is a criterion of what can be accomplished elsewhere with this procedure. What is one man's meat may be another's poison, and for this reason each particular problem of supply cost control must be solved by means adaptable to the prevailing circumstances. Neither is Pocahontas Fuel satisfied that it has reached the ultimate as far as its own needs are concerned, and efforts are being directed toward improvement of procedures so that IBM prepared reports may be utilized to the fullest possible extent.





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Here's why . . . Joy bit blanks are precision machined from a fine alloy steel, and a controlled heat treating process adds strength to give rugged service and long life. The carbide insert, a special grade selected for its extra footage-producing ability, is brazed to the bit blank by an exclusive process. This provides a super tough bond between the carbide and the bit blank—there's no lost time due to lost carbides.

These features, plus the excellent chipway design that provides maximum hole cleaning ability, keep Joy bits drilling longer. You get more hole per bit . . . more hole per shift . . . more production.

For proof of performance, contact your Joy representative. He will be glad to demonstrate Joy Tungsten Carbide Bits.

YOU'LL FIND YOUR BIT SIZE IN THIS CHART

SHOULDER DRIVE	BOTTOM DRIVE	TAPER SOCKET
1½″	*2½″	1¼″
1⅝″	*2¾″	1⅜″
1¾″	*3″	1½″
1⅞″	*3¼″	1⅝″
2″	*3½″	1¾″
2⅛″	*4″	
2¼″	*4½″	
2⅜″	*5″	
2½″	†4″	
2¾″	†4½″	
3″	†5½″	
*3½″	†6″	
*4″		
*4½″		

NOTE: * x-type.
†Rose design
Others are cross type.

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AMC COAL SHOW -1959

IT'S difficult to keep from using superlatives when it comes to describing the 1959 Coal Show of the American Mining Congress. Certainly the Show itself can be called "stupendous", the new mining equipment "fantastic", and the crowd's enthusiasm "overwhelming"—without stretching the facts.

The statistics alone are impressive. For four days, May 11–14, close to 14,000 mining men from all over the United States and several foreign countries examined the products of over 250 manufacturers. Several million dollars worth of machinery was displayed in a record breaking exhibit area of 143,175 net square feet. Manufacturers let no obstacles stand in the way of presenting their latest developments, generally with full-scale machines in operation.

The technical sessions attracted capacity crowds to hear some of industry's ablest men report on up-to-the-minute advances in mine operating techniques, coal preparation, management problems, and safety. The high quality of the papers sustained the interest of the mining men throughout the week. In addition to nine regular coal sessions, a special session on "Cost Cutting in Open Pit Mining," which was set up to serve industrial minerals producers, attracted particular attention. This year's excellent program can be directly credited to the efforts of the Program Committee which was headed by E. P. Humphrey, director, Stonega Coke & Coal Co.

Thus, the thousands of coal miners who attended were able to study the newest and best of equipment at first hand. They had the opportunity to hear and talk with industry leaders on subjects of great importance in producing the country's basic source of energy—coal. Undoubtedly, the resulting exchange of ideas will lead to safer and more efficient mining methods and equipment. And finally, they had innumerable occasions to share the comradeship of one of the finest groups of men found anywhere in the world. In total, the 1959 Coal Show demonstrated the aptness of the theme—"Coal Powers America's Future."

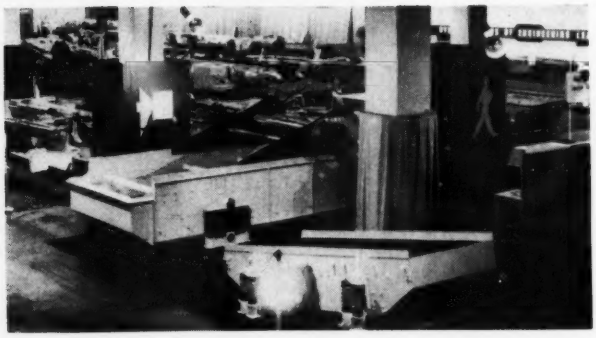
Program Committee Chairman E. P. Humphrey thanked convention speakers for their contributions to the Coal Show program

THE SHOW

Once again mining equipment manufacturers and suppliers outdid themselves in providing attractive and informative exhibits. From the complex array of continuous and conventional mining machines; the elaborate displays of coal preparation equipment; the impressive showings of electrical supplies; the prominent exhibits of explosives, the immense haulage and earth-moving equipment; past the many intriguing booths stressing all of the supplementary mining supplies and services to the large blast hole drills that were in operation on the Mall—a tour of Cleveland's Public Auditorium showed that no stone was left unturned to make this the greatest Coal Show yet. Equipment too large to be shown in full size was represented by model, or component part. Where operating scale models were not feasible, full advantage was taken of motion pictures to illustrate operating principles.

Coal mine operators reciprocated with a deep interest in each facet of the many sided array of mining tools that was spread before them—ample proof of their dedication to mining the Nation's foremost source of energy at ever increasing rates of productivity.

To even a casual viewer the advancing technology of the industry was apparent. In underground mining equipment it was easy to see that the switch to a-c power is under way with a full head of steam. As to strip mining equipment, increased capacity and more power were the magic



Exhibits were larger and machines more complex

words. In explosives the emphasis continues to be on ammonium nitrate blasting agents. Fine coal cleaning and automatic controls were stressed in coal preparation. In backing up these trends the many progressive suppliers displayed a seemingly endless variety of equipment, supplies and services designed to produce more coal at lower cost.

There can be no doubt about it, hours or days spent in visiting the Exhibition Hall will pay off time and time again in the months to come. The opportunity to check and compare, investigate and analyse will be translated into increased mining productivity in many ways.

Much of the equipment on display was in operation, giving each convention goer an opportunity to visualize the application of each particular machine to his property.

The coal industry can be justly proud of the mining equipment manufacturers for their cooperation in bringing U. S. coal mining to a point that makes it the envy of every coal producing country in the world. The 1959 Coal Show was ample proof of that fact.

MANUFACTURER'S DIVISION MEETING

The Manufacturer's Division of the American Mining Congress met Wednesday morning, May 13. The meeting was presided over by Chairman W. L. Wearly, president of Joy Manufacturing Co. Julian Conover, AMC executive vice president reported on the activities of the organization during the past year and plans for the future. Conover related that, "Cooperation between manufacturers and operators continues at a high level, both in matters of Government policies and in our technical work to develop improved mining practices and equipment." He reviewed last year's Mining Show at San Francisco and outlined plans for the western Convention in Denver, September 14–16. For next year's Coal Convention, Pittsburgh, with its "new look," is being given active consideration, and a final decision will be announced shortly.

Members elected to the Division's Board of Governors for the term expiring 1962 are: D. E. Davidson, vice president, Link-Belt Co.; E. T. Eggers, manager, Wire Rope Products Division, American Steel and Wire Division of U. S. Steel Corp.; William E. Goodman, chairman of the board, Goodman Manufacturing Co.; R. L. Halsted, general manager, Industrial Equipment Division, Allis-Chalmers Manufacturing Co.; J. B. Long, president, The Long Co.; J. T. Ryan, Jr., president, Mine Safety Appliances Co.; J. H. Sanford, manager, Mining Division, Ohio Brass Co., and J. E. M. Wilson, vice president, Jeffrey Manufacturing Co. Henry Barnhart, vice president and general manager, Baldwin-Lima-Hamilton Corp., was elected to fill an existing vacancy for the term expiring 1961. Membership on the Board of Directors totals 24 leading manufacturers of all types of mining equipment.

The following officers of the Manufacturers Division were elected for the calendar year 1960: chairman, Albert E. Seep, president, Mine & Smelter Supply Co.; vice chairman, D. E. Davidson, vice president, Link-Belt Co.; second vice chairman, Austin Goodyear, president, Hewitt-Robins, Inc.; third vice chairman, J. H. Sanford, manager, Mining Division, Ohio Brass Co.

An important decision affecting future AMC conventions was also made during the meeting, following discussions by the AMC Board of Directors and the Manufacturers Division Board of Governors. Beginning after the 1961 Coal Show in Cleveland and the 1962 Mining Show in San Francisco, there will be a "stretch out" of the Expositions, with the Coal Show and the Mining Show held every three instead of every two years, and with "paper" Conventions in the third year.

BOARD OF DIRECTORS MEET

A luncheon meeting of the Board of Directors of the American Mining Congress, called by President Raymond Salvati, was held on Monday of Coal Show week. A number of important committee appointments were made and various questions of policy were discussed and referred to appropriate committees for attention. Julian Conover gave a run down on the work of the Mining Congress for the current year; and a discussion of Washington developments which affect the mining industry ensued.

OPENING SESSION

The opening session got under way Monday morning, May 11, with presentation of the Colors by a Color Guard from Scout Troop 211, Cuyahoga Council, Boy Scouts of America. Following the pledge of allegiance to the flag, an invocation was asked by the Reverend Marvin E. Wilt, Faith Lutheran Church, Lakewood, Ohio.

Raymond E. Salvati, president, Island Creek Coal Co., and president, American Mining Congress, presided during the opening ceremonies and, in his introductory remarks, commented on the great strides made by the mining industry in raising productivity to its present levels. He stressed the benefit of Mining Congress meetings and expositions, pointing out the great advantages that can be gained from such meetings. Salvati then called upon Jesse F. Core, vice president-operations-coal, U. S. Steel Corp., and chairman, AMC Coal Division; E. P. Humphrey, director, Stonega Coke & Coal Co., and chairman of the National Program Committee, and W. L. Wearly, president, Joy Manufacturing Co., and chairman, AMC Manufacturers Division, for a few remarks. Each of these officials praised the cooperation of equipment manufacturers and coal operators in their never ending search for machines that will do a better job of producing coal and maintaining the industry's competitive position.

Following the introduction of other dignitaries present on the platform, the opening ceremonies were concluded by the Reverend Lawrence

Participants in the opening ceremonies included (left to right): Reverend Marvin E. Wilt, who asked the invocation; Reverend Lawrence M. Wolf, who pronounced the benediction; Jesse F. Core, chairman, Coal Division; William L. Wearly, chairman, Manufacturers Division; Raymond E. Salvati, president, American Mining Congress; E. P. Humphrey, chairman, Program Committee; Wilmot C. Jones, chairman, Floor Committee, and Julian Conover, AMC executive vice president

M. Wolf, St. Procop's Catholic Church, Cleveland, who pronounced the benediction.

The first technical paper of the Convention was given by John B. Kebblish, general superintendent, Mountaineer Coal Co., Fairmont, W. Va., whose subject was "Face Ventilation and Dust Control with Continuous Mining Equipment." Kebblish described his company's experiments with various methods of auxiliary ventilation to dilute concentrations of gas and dust at the face of continuous sections. Starting with line brattice, Mountaineer Coal Co. progressed through experiments with blowing fans and auxiliary tubing, exhaust fans and auxiliary tubing, wet type dust collectors mounted on the machine, and a combination blower-exhaust system. He stated that a combination system, using a hydraulically driven centrifugal fan mounted on a mining machine and an auxiliary exhaust fan equipped with 100 ft of well installed 14-in. tubing, has proven to be the most efficient and effective method of face ventilation so far used. Methane liberations of up to 40 cfm can be safely and efficiently handled with this system, Kebblish said.

"Advances in Roof Control" was the topic of a paper by James T. Jones, assistant superintendent, Mather Collieries, Mather, Pa. Jones evaluated present method of roof control procedures being practiced on continuous mining sections. "In regard to roof bolting," he said "a definite step forward has been taken by mounting roof bolting equipment on either side of ripper type machines. Bolting for roof control over a boring type machine is more complicated, but this problem has been overcome in a West Virginia mine where roof drills are pulled along the side of the boring machine.

Jones went on to say that recently a mining machine has been developed by the U. S. Bureau of Mines which will provide a continuous support over the operator of a continuous mining machine while operating in the face area. The jacks are designed to carry a total load of 72 tons. The Bureau also, Jones stated, is continuing its experimental work in roof cementation by injecting resins into the rock strata over the coal seam into pressures varying from 600 to 1150 psi.

The opening session was concluded with a paper by Bruce E. Duke, assistant to the manager, Bethlehem Mines Corp., Johnstown, Pa., whose paper was entitled "Coal Transportation—Continuous Mining Equipment."

With about 50 percent of the coal produced by Bethlehem Mines Corp. coming from continuous mining machines, Bethlehem's ultimate goal in transportation is to have a completely continuous system. However, to date, shuttle cars have proved the most reliable for coal haulage. Results from experiments with continuous types of haulage equipment have been im-

"Could we use it effectively?"

proving, though. Over a relatively short period of time this year a production rate of 54 tons of coal per man was achieved in a 60-in. seam using extensible belts and a bridge conveyor behind a continuous mining machine. During the first six shifts of operation in a 84-in. seam, coal was produced at the rate of 44 tons per man.

Duke concluded by saying that experiments with continuous haulage systems that are now available have convinced Bethlehem Mines Corp. that no one has come up with the solution to this pressing need in the industry.

"Let's see now, are they in the right order?" a session speaker asks himself as he checks out his slides

UNDERGROUND POWER

Underground Power was the subject of a Tuesday morning session at which R. G. Heers, manager of Mining & Raw Materials, Kaiser Steel Corp., Fontana, Calif., presided as chairman. S. P. Carter, chief engineer, Coal Division, Armco Steel Corp., Montcoal, W. Va., was floor committeeman.

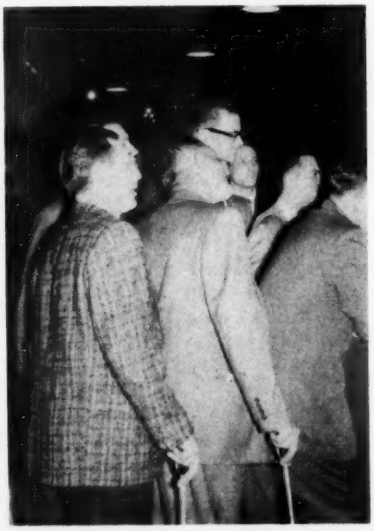
The first speaker of the session was James G. Wiley, electrical engineer, Rochester & Pittsburgh Coal Co., Indiana, Pa., who discussed the question, "Are A-C Sections Practical in a D-C Mine?" Wiley pointed out that the practicability of using a-c equipment in an existing d-c mine, is affected by various economic considerations. Items to be taken into account before the final decision is made include: adaptability of the existing underground power system; use of existing equipment; cost of a second underground transmission system; equipment maintenance costs, and the improved safety features of a-c power systems and equipment. He said that in one of R & P's West Virginia mines a-c and d-c are mixed within the mine sections. Boring type continuous mining machines are operated on a-c, while service equipment is operated on 250 volts d-c. When the continuous mining machines were installed it was decided that a-c was needed to provide the proper voltage regulation. However, auxiliary equipment was in too good condition to scrap, and it was decided to keep it in operation on 250 volts d-c. Also, this is the only mine in R & P's operation that utilizes 250 volts d-c. Wiley explained that the big problem is the time and material needed to keep both a-c and d-c feeder lines up to the face area.

Joseph B. Albasin, mechanical & electrical engineer, Youghiogheny & Ohio Coal Co., Martins Ferry, Ohio, in discussing Wiley's paper said that his company's experience was exactly the same as that of Rochester & Pittsburgh Coal Co. Unless unusual conditions prevail, it is generally not wise to mix the two types of power, he said.

Both authors agreed that there was a definite movement towards all a-c power systems in underground coal mining.

A thorough engineering study at the new Thunderbird mine of Ayrshire Collieries Corp. near Sullivan, Ind., led to the decision to use a-c power underground, according to L. E. Briscoe, electrical engineer, Ayrshire Collieries Corp., Indianapolis, Ind. Briscoe presented a paper entitled, "Why We Decided to Use A-C Power at Our New Thunderbird Mine."

Individual points that were considered in making this decision included a selection of face equipment, primary transportation, and handling of men and supplies. The company's final decision was to make the mine all a-c power for five reasons: (1) first cost, (2) safety to shock and fire hazards, (3) maintenance, (4) flexibility and (5) efficiency. Extensive cost calculations were prepared for both a-c and d-c operation. The comparison of the two installations indicated that the cost of a d-c power supply would be 33-1/3 percent to 43 percent greater than for an a-c power supply.

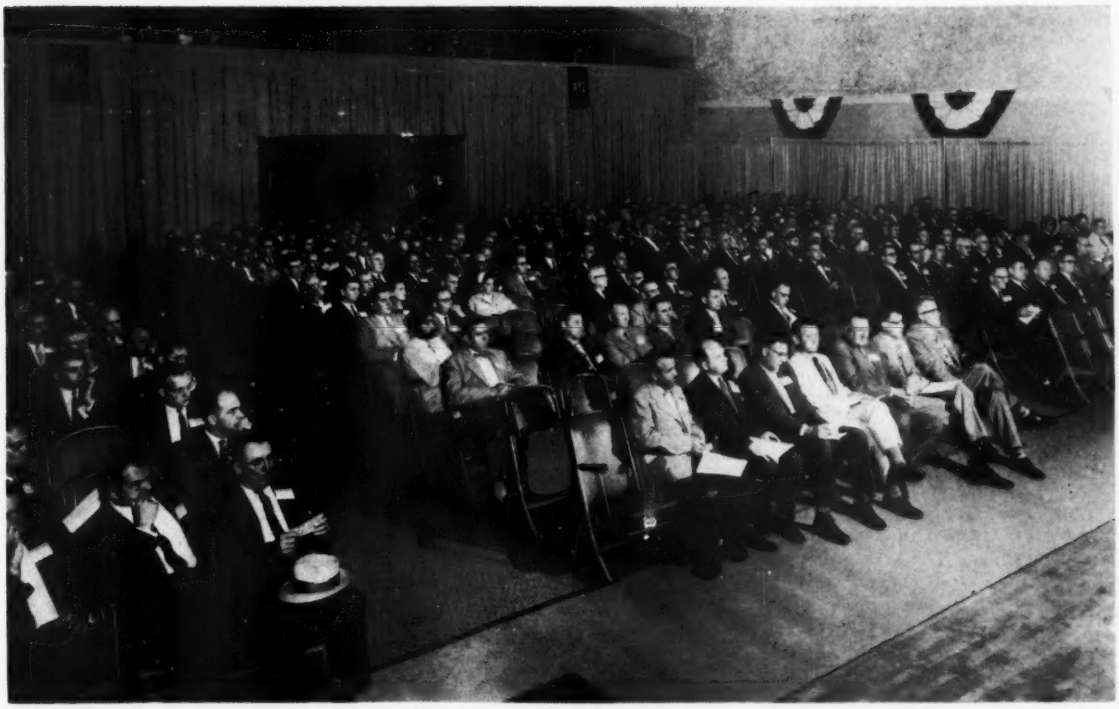


There were many new machines on display to catch the attention of convention-goers

John W. Looney, electrical engineer, Pocahontas Fuel Co., Pocahontas, Va., described his company's "Experience with High Voltage Distribution Systems Underground."

In December 1954 Pocahontas Fuel Co. began installing 13.2 kv underground distribution systems at its property. Three conductor No. 2 cable, with the following specifications was chosen as a standard for underground distribution: three conductor, semi-con tape, 19/64-in. super coronal insulation, colored semi-con tape, shielded, twisted with No. 6 AWG strand coated ground wire, 8/64-in. neoprene or geoprene jacket. A 2/0, three-conductor armoured cable was chosen as a standard for boreholes. It was further decided to terminate each 1000 ft of cable with disconnecting potheads because of the advantages of working with sectionalized cable.

Of the 90,000 ft of cable that the company has had in use from one to four years, there have been 12 outages due to cable failures. Eight were due to slate falls; two could not be traced to external causes—attributed to either defective or mishandled cable; one was caused by an air receiver blowing up and cutting the cable, and the last failure was in a pothead and could have been due to poor installation. In order to minimize trouble due to slate falls, the



An especially timely and interesting program brought a near-capacity crowd to each session

company prefers to handle the cable along the haulway. It has been found that cable that is hung will ride down with a relatively large piece of rock without being damaged. When cable passes through a section of bad top, a double line of timbers is normally set to protect the cable. At any point at which the cable must cross the track, it is installed in a protected trench within the top or bottom.

Pocahontas Fuel has had excellent results in voltage regulation, no equipment failure traceable to the high voltage and a minimum of cable failures that could have been caused by the higher voltage.

The final paper of this session was entitled, "Advantages of Higher Utilization Voltages Underground," and was presented by James A. Erskine, chairman, AMC Underground Power Committee and electrical engineer, Eastern Gas & Fuel Associates, Pittsburgh, Pa. Erskine pointed out that, since the introduction of heavy face equipment, many operators, recognizing the limitations of direct current, have gone to a-c power, using a 440 volt grounded "Y" system. However, he said, while this is a big step in the right direction, many have found that there are still limitations with 440 volts and are advocating a higher voltage to improve voltage regulation, reduce inrush current or increase distance of travel on secondary feeders. Should it be necessary to raise the voltage, a great deal may be gained by going to 550 volts. With this higher voltage, amperes required per horsepower are reduced approximately 20 percent and this could be a major factor where cable heating and regulation or inrush current is a problem. Other factors much in favor of 550 volts are that it is a recognized standard voltage and motors and controls may be purchased at the same price as is 440-volt equipment.

Erskine also pointed out that there has been some talk of going to a higher voltage than 550 and this will be necessary if the manufacturers of mining equipment continue to raise horsepower. If, and when, this time comes, he stated, since there is no standard voltage between 550 and 2300 volts, the higher voltage probably will be considered. If this occurs, there will be many electrical problems to solve. These will consist of motor design, the design of controls which, of course, will be much larger, higher short circuit current, and the safety of operation.

STRIP MINING

The first of two Strip Mining sessions was held Tuesday morning, May 12. Arnold E. Lamm, president, Sunnyhill Coal Co., Columbus, Ohio, was session chairman. W. W. Dukes, vice president, Stonefort Corp., served as floor committeeman.

Problems encountered in "Multiple Seam Stripping," were described by O. E. May, manager, Paradise Mine, Pittsburg & Midway Coal Mining Co., Drakesboro, Ky. May said that in planning multiple seam stripping, his company does not look at the job as separate stripping propositions, but instead tries to use some of the equipment and men for more than one job. Initial planning needs to be flexible and there must be plenty of manpower and equipment on hand to get the several jobs done in the order required, and in the time allotted, May continued. The tendency is to underestimate the problems that will arise rather than to overestimate. However, properly handled, a mulitple seam stripping job means economy and cheaper coal.

M. J. Gleason, manager, Contract Drilling Division, E. J. Longyear Co., Minneapolis, Minn., presented a paper on "Recent Applications of Wire Line Coring Techniques in Coal Exploration." Basically, wire line coring differs from conventional coring in that a retractable tube is used. At the end of each core run, the core-laden inner tube assembly is hoisted to the surface through the drill string, as opposed to the con-

ventional method wherein it is necessary to pull the entire drill string in core barrel in order to recover the core. Main advantages gained from wire line coring can be listed as: (1) the string of drilling tools can be left in the hole when the core is pulled; (2) there is less danger from breaking down the walls of holes in poorly consolidated material; (3) the attrition of weaker strata exposing the drill hole is minimized; (4) core barrel life is normally greater. The two most important benefits from the use of wire line equipment can be said to be increased core recovery in critical horizons and reduced diamond costs. This complete paper appears on pages 64 to 67 of this issue of *Mining Congress Journal.*

The rest of the strip mining session was devoted to methods of recovering coal from highwalls. John R. Karnap, general manager, Elm Development Co., Oak Hill, W. Va. described "Highwall Augering With a Twin Auger." In mid 1957 a 24-in. diameter twin auger was introduced to the coal mining industry. Elm Development Co. records show that the 24-in. twin, which is the smallest of its kind, produces tonnages which are comparable to that from a single 36-in. auger, which in turn produces tonnages sufficient to command a volume market as well as to justify the initial development cost of the auger operation. Some of the seams that have been developed for augering because of the availability of the twin auger are the Jellico, Hazard No. 4, Swanee, Powellton, Sewell and many seams with thin coal above and below large partings. Elm Development is obtaining an average production of 420 tons per shift using five men on the auger operation.

The second speaker on highwall mining was J. C. Forrest, Jr., president, Harcliff Coal Co., Pittsburgh, Pa., who described an operation in northwestern Pennsylvania using an auger type continuous mining machine followed by an extensible belt to drive 1000-ft rooms into a highwall. The operation is in the Kittanning seam and coal height varies from 40 to 42 in. Five and a half ft pillars are left between each 9½-ft wide room, with a 20-ft barrier pillar being left after each length room. A pit width of 70 to 90 ft is required for the operation, and approximately 150 ft of highwall is exhausted per month.

"Remote Control Highwall Mining" was the topic of a paper by J. W. Heimaster, Bore Mining Department, Union Carbide Chemicals Co., South Charleston, W. Va.

Union Carbide has been interested in remotely-controlled mining since 1946 and has had such equipment in operation since 1949. A major improvement that has been accomplished, in addition to beefing up earlier models of the continuous mining machines, has been the assembling of conveyors into a continuous train rather than assembling and dismantling the conveyor train at the portal. This arrangement not only eliminates time lost in connecting conveyors, but greatly reduces the time lost backing out of a borehole for rebitting, etc. The latest design of conveyor is now a 60-in. chain and flight conveyor as compared to the earlier 24-in belt conveyor. Roof falls up to six ft. wide, 10 in. thick and 100 ft long can be caught by these wide conveyors and carried to the surface without incident. Production records established to date have two men loading coal at an average rate of 400 tons per shift working in a 44 to 48-in. seam. Consideration is being given to the design of a machine to recover pillars between boreholes.

The complete text of Heimaster's paper appeared in the May issue of *Mining Congress Journal.*

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The second session on Strip Mining was held Thursday morning, May 14, with W. J. Crawford, vice president, The Enos Coal Mining Co., Oakland City, Ind., presiding. James Reilly, vice president, Hanna Coal Co., Cadiz, Ohio, served as floor committeeman.

James P. McDowell, superintendent, River King Mine, Peabody Coal Co., Freeburg, Ill., presented a discussion on "Economic Aspects of Large Stripping Shovels." The strip mining industry knows that shallow overburden reserves have been very well depleted and future coal production by stripping must be from high ratio and deeper overburden reserves. Several manufacturers have developed stripping shovels with larger dippers and greater ranges than were formerly obtainable, and the acceptance of these units by the industry is tangible evidence that they are performing an economic service.

McDowell went on to compare performance of a Marion 5320 shovel equipped with a 95-ft boom and a 13-yd dipper with the latest Marion 5760 shovel, equipped with a 140-ft boom and a 70-yd dipper. He said that the newer machines can work on a highwall 37½ percent greater than can the older machine. Excluding administration, supervision, interest, taxes, and insurance and other general overhead items, the direct operating cost of the older, smaller shovel, can be estimated at 5.95 cents per cu yd, while the same cost for the newer shovel is 4.80 cents per cu yd. The use of larger machines, McDowell said, will enable a strip mine operator to extend his stripping reserves, allow a larger mine, and where reserves are sufficient to justify the expenditure, will reduce overburden handling costs. He concluded by saying that "We, as operators, never yet bought a stripping shovel that is big enough, or too big, for our job."

"Economic Aspects of Large Stripping Draglines" was the title of a paper given by Lafe Stewart, chief engineer, Maumee Collieries Co., Terre Haute, Ind.

Stewart said that there are certain conditions on both surface and coal topography which sometimes preclude the use of a shovel as a stripping unit. If the coal reserves lie in various scattered small bodies, or if the coal seam itself is very rough in character, or thin, selection of a dragline is clearly indicated. The dragline moves overland with much less difficulty than does the shovel, and it is a far more effective tool for opening box cuts because of its mobility and longer reach.

Although the development of large draglines has lagged behind shovel development, draglines have approximately 40-yd capacity and dumping radius of about 200 to 220 ft are now available. Stewart said that such a machine can strip up to 120 ft of overburden without an auxiliary machine and with only about 12 percent rehandling in stable overburden. This would only be possible, however, by taking advantage of additional reach created by filling the pit and rehandling the wedge of fill against the highwall. He concluded by saying a point is rapidly approaching in the design of draglines where a complete redesign will be necessary if materially larger machines are to be made.

D. S. Blount, president, Raleigh Eagle Coal Co., Ameagle, W. Va., discussed "Machine Loading Blast Holes with Ammonium Nitrate." Raleigh Eagle operates a typical southern West Virginia strip mine—working three to five seams in mountains that are virtually up and down. The steepness of the hills, with the sand rock outcropping directly above the coal, makes it impossible to drill vertically. In most cases the slope above the operation is steeper than

45°. Because of the thickness of the dense sand rock, it is necessary to concentrate as much explosive as possible at the back of the hole. Raleigh Eagle has had fine success with a Jetloader mounted on the back of a truck. Prilled ammonium nitrate is blown into the holes with the blow-loader at the rate of one 80-lb bag in 15 seconds. Two-hundred and forty lb of explosives is used per hole. The company has found that it can get a third again as much blown material into a unit length of hole than it can with bag material.

"What was probably the first application of 7200 volts in an open pit portable power distribution system was put into operation in the fall of 1955 at the Hanna Coal Co., Georgetown No. 12 Mine," R. V. Bovenizer, electrical engineer, Hanna Coal Co., Cadiz, Ohio, said as he introduced his paper, "Power Distribution in Strip Mines at 7200 Volts." The 7200-volt system was put into operation to supply the "Mountaineer," a 60-yd shovel which has a total a-c connected volt of 6000 hp. Power to service Hanna's various operations is purchased through a single metering point and distributed at 67 kv over approximately 100 miles of company built and maintained transmission lines.

Bovenizer concluded by saying the 7200-volt portable distribution system can be made as safe as a lower voltage system when properly designed and maintained. The development of larger shovels is certain to require even higher utilization voltages, and design and development of portable cables, field switches, and methods of connecting cable lengths to apply to portable equipment at 13,800 volts may be required in the near future.

Theron G. Gerow, consulting engineer, Minneapolis, Minn., concluded the strip mining session with a paper on "Future Trends in Coal Mine Haulage." Based on the views and opinions of manufacturers and coal mine operators, Gerow stated that coal mine operators want to haul bigger loads farther and faster and at a lower cost. Manufacturers want to supply such units if the market will support the necessary development, at a profit, and if they can develop satisfactory motors, transmissions, axles and tires for the bigger loads.

Gerow stated that 50-ton capacity trucks can now be accepted as standard units and 70, 80 and up to 100-ton units are being tested. Mine operators want more engine power, with 400 to 450 lb of gross load per horsepower, the apparent choice. Naturally aspirated diesel engines, derated in horsepower are favored. For the ultimate in payload to gross load ratios, however, turbo-charge engines are being considered. Straight transmissions seem to be favored, yet there is a recognition of the advantages of a properly designed torque converter.

"Check and compare" was the order of the week

One of the apparent immediate bottlenecks in larger truck design is tires. Tire builders must face and solve the problems that will be met in hauling 100 ton and greater loads.

SAFETY

Marling J. Ankeny, director, U. S. Bureau of Mines, Washington, D. C. presided at a session on Safety, Tuesday afternoon. Jack Whittaker, vice president, Pittsburgh Coal Co., Division of Consolidation Coal Co., Library, Pa., was floor committeeman.

"A Continuous Methane Monitoring System at the Working Face" was the title of the first paper and was presented by Robert S. James, chief, Branch of Electrical-Mechanical Testing, U. S. Bureau of Mines, Pittsburgh, Pa. James described how concerted effort by several industries promises a major break-through in the development of a system whereby equipment working in the face will be shut down when the methane content of mine air builds up to a dangerous concentration.

In reviewing progress to date, James said that one manufacturer has developed a detector alarm combination based on the velocity of sound through different gases. In addition one manufacturer has developed a methane-alarm device based on catalytic oxidation of methane, and one manufacturer has developed an electronic device suitable for use as a power-shutoff component. Several manufacturers have shown devices that may be of value in this program. Others have been interested in developing devices.

The Bureau feels that progress so far and materials available at this time indicate that the mining industry will soon have a permissible methane monitoring system available. From a practical standpoint, this will mean that the industry will be able to have the methane content of the mine indicated automatically at all times.

James' interesting paper is presented in full beginning on page 44 of this issue of *Mining Congress Journal.*

William O. Barnard, Jr., general superintendent, Christopher Coal Co., Osage, W. Va. presented a very interesting paper on "Mine Fires in Northern West Virginia." Barnard pointed out that in the last ten years there have been 28 mine fires in northern West Virginia. Twelve fires were caused by electrical short circuits and equipment, seven by falls on power lines, four by belt fires, three concerned gob lines or outcrop fires, and two fires could be blamed on haulage.

Barnard said the most important phase of mine fire fighting is "Fire Prevention." When fires do happen, they should generally be attacked directly and if this does not bring them under control, indirect methods can be employed. Pointing out that time is a most important factor in any fire fighting scheme, he stressed the need for training men in fire fighting techniques and in holding surprise fire drills. Every effort must be made to prevent mine fires, but if there is a mine fire the company must be prepared to fight it directly at its earliest stage with material that is readily available and with men that are trained to take positive direct action. If all else fails, the mine must have

definite plans for sealing or flooding fire areas to safeguard both life and property, Barnard concluded.

"Fire Resistant Hydraulic Fluids for Coal Mines" was the topic of a paper by A. S. Morrow, senior engineer, Products Application Department, Shell Oil Co., New York. Morrow noted that, because of the expanding use of hydraulically actuated machinery in the mines, an increasing volume of hydraulic oil is being consumed by the coal mining industry. Since 1956 the Bureau of Mines has been working in cooperation with several manufacturers of hydraulic oils to develop a less flammable, or fire-resistant, hydraulic fluid which could be used in mining equipment. These experiments have led to the selection of a water-in-oil emulsion—the oil surrounds minute water globules—which is fire resistant, relatively cheap and performs satisfactorily as a hydraulic fluid. These fluids have undergone laboratory and field tests which have pointed out that, although these fluids are similar to oils, they are not identical to oils and must be handled in a somewhat different manner. Good maintenance practice is very necessary.

The complete text of Morrow's paper was carried in the May issue of *Mining Congress Journal.*

"While many hazards exist in strip mines under normal mining conditions, many of these same hazards become much more serious under adverse weather conditions and, in addition, new hazards are developed," according to Eugene E. Quenon, director of safety, Peabody Coal Co., St. Louis, Mo., who presented a paper on "Safety Problems Involved in Strip Mining." He continued by saying "weather does have a direct bearing on the frequency and severity rate in coal strip operations."

Emphasizing that in the final analysis safety depends in a large part on individual workers, Quenon stressed the importance of training and supervision.

Dennis J. Keenan, vice president, Sterling Coal Co., El Mora, Pa., concluded the safety session with a paper entitled "Much Can Be Done to Improve Coal Mine Safety." Keenan advanced the thesis that a sound coal mine safety program has to be looked upon as an engineering problem if the program is to achieve its ultimate potential. He said that safety should receive the same thorough study that a problem in ventilation, transportation, or coal preparation does. There is no short cut to safety in coal mines. It is a task that must be worked on constantly by all parties concerned. However, the industry can have real safety through supervision, inspection, education, application and explanation.

SPECIAL SESSION FOR INDUSTRIAL MINERALS PRODUCERS AND METAL MINERS

Lewis J. Patterson, manager, Northern District, Michigan Limestone Div., U. S. Steel Corp., served as chairman of the only session for "non-coal miners" at the Convention.

The program started on a subject of intense interest as Robert W. Bell, of the Erie Mining Co., operating in the Lake Superior District, Mark F. Withey, Jr., of Materials Service Corp,. operating in the Chicago area, and Frank Coulson of the Central Ohio Coal Co. of Zanesville, Ohio, conducted a symposium on "Blasting Wet Holes with Ammonium Nitrate." Formerly thought to be ineffective where wet hole conditions exist, these men pointed out that with ingenuity, a little extra care in preparation, and close engineering control, economies can be made using this inexpensive blasting agent under wet conditions.

An extremely interesting paper by C. R. Fahnestock, application engineer, Caterpillar Tractor Co., described a new technique developed by his company to determine the composition of material up to 100 ft below existing ground surface. This technique holds real promise for the earth-moving industries by helping operators select the proper equipment for any given job.

Daniel J. Snyder, service metal-

Motion pictures were used effectively by manufacturers of equipment too large to exhibit

lurgist, Steel Operating Div., U. S. Steel Corp. described new constructional steels that are being used extensively by industry today for their high-strength properties, good toughness, and resistance to abrasion. He recounted many substantial savings to the operators through the use of these steels—savings that have been accomplished through weight reduction, lower fabricating costs, and reduced maintenance.

"The Economics of Various Types of Quarry Haulage" was discussed by Orrin D. Weeks, acting plant manager, Calaveras Cement Co., San Andreas, Calif. He pointed out the great potential for cost cutting that is offered by modern trucks, improved conveying systems, incline skips, large scrapers and self-loading transporters; but he went on to say that it is usually exceedingly difficult and costly to change over a complete haulage system. Exacting studies, Weeks said, should precede a change of haulage method. He described in some detail the type of cost analysis which should be made to justify such a change over.

The final presentation on the session was a discussion of "Cost Reduction in Quarrying Through Automation" by J. E. Doyen, Western-Knapp Engineering Co., Chicago. He reviewed the proven basic applications of automation which have been used successfully in industrial minerals processing and materials handling plants. Doyen described a number of electronic innovations which hold great promise for cost reduction in the mining industry.

COAL PREPARATION

The session on Coal Preparation was held Wednesday afternoon, May 13, with Richard F. Wesner, vice president and general manager, Boone County Coal Corp., Sharples, W. Va., as chairman. Loy Updegraff, Bituminous Coal Research, Inc., Columbus, Ohio, was floor committeeman.

"Centrifuging Stoker Coal" was the title of the first paper of the afternoon and was given by E. A. Watters, Jr., chief engineer, Joanne Coal Co., Pittsburgh, Pa. Watters said that his company produces a little over 100 tph of ¼ by ¾ in. stoker coal from its coal preparation plant at Rachel, W. Va., about one-fourth of the total clean coal output. The plant is equipped with sufficient conveying and thermal drying facilities to handle only 30 tph of this coal and 70 tph had to be dewatered in some

Interest in individual exhibits was exceptionally high

manner. It was decided to install a centrifugal stoker dryer to reduce the moisture in ¾ in. by 0 moisture in slack coal product, thereby improving its Btu value, increase sales in the winter by elimination of freezing in railroad cars without further coal treatment, and develop further markets for the ¼ to ¾ in. pea stoker coal.

The centrifuge was installed directly over the drag tank which allowed the effluent from the centrifuge to discharge freely into the ¼ in. by 0 clean coal drag tank. The centrifuge has been in operation since the first of the year and the company has had no serious expenditures for repairs or down time. Expectant screen life is about 2500 hours and the unit has been drying ¼ by ¾ in. coal to a surface moisture of 2 to 2½ percent.

Dr. C. Krijgsman, head, Coal Preparation Division, The Dutch State Mines, presented a paper on "The Dutch State Mines Heavy Medium Cyclone Washer Systems." "Although heavy medium washers for the treatment of nut size and larger coal are well introduced in the United States, heavy medium systems for small coal entails special problems regarding the efficiency of the separation as well as the regeneration of the magnetite," Dr. Krijgsman said. He also said difficulties concerning the efficiency of the separation for small size coal are bypassed by the cyclone washer. Dr. Krijgsman went on to say that the cyclone washer is widely used in the United States for the treatment of iron ore and has proven successful in this area. He then stated that the heavy medium cyclone will not only clean American coal but will do so with a remarkably high degree of efficiency regardless of the specific gravity used, and as long as the feed tonnage of the cyclone is not exceeded (up to 50 tph for a 20-in. diameter cyclone), wide variations in the amount of rejects will not affect the cleaning efficiency.

Dr. Krijgsman's very interesting paper has been published in two parts. Part I appeared in the May issue of *Mining Congress Journal* and Part II is in this issue, beginning on page 91.

W. L. McMorris, Jr., director, Coal Preparation & Distribution, United States Steel Corp., Pittsburgh, Pa. discussed "Froth Flotation—A Tool for Increased Profits." McMorris approached the subject by analyzing why there is a rekindled and growing interest in the application of froth flotation to the problems of the coal industry. He said that coal producers who are wet cleaning are facing a number of problems which can be eased to some degree by the better cleaning of fine mesh coal, by the additional recovery of marketable products, or a combination of both. First and foremost of these problems is the maintenance of a competitive fuel cost despite rising labor, material and supply costs. While the over-all cost of cleaning fine mesh coal is higher than cleaning coarser coal, in many instances the cost of cleaning and recovering fines which would be otherwise wasted is less than the cost of mining additional raw coal.

McMorris also pointed out that increasing pressure for clean streams may eventually make it mandatory on the operator to prevent any black water reaching the local water shed. He pointed out that high quality can have an important bearing on marketability for utility coal, and that complete cleaning is important to the metallurgical customer.

Each individual operator has his own problems of production, cleaning and marketing, as well as waste disposal, McMorris said. The degree of preparation must be determined on the basis of the most economical operation to suit these problems. An operator who is not now cleaning fine coal may find that it is profitable to do so. If he is wet cleaning fines and has high slurry losses, he may find it more profitable to salvage coal from these slurries. In either

case, McMorris added, engineering studies may well disclose that froth flotation can be a "tool for increased profits."

"The Electrical Side of Preparation Plant Design" was discussed thoroughly by D. E. Hamilton, application engineer, Industrial Engineering Section, General Electric Co., Schenectady, N. Y. Hamilton said that in viewing the electrical equipment to go into a preparation plant the following points should be carefully considered: (1) total power requirements; (2) power distribution equipment; (3) motors; (4) control equipment, and (5) selection of cable. He explained that a check of quite a number of plants already built indicates that, where there is little or no fine coal cleaned, between two and three connected hp per tph of plant capacity has been required. When considerable fine coal cleaning is involved, the figures may well be as high as four to five hp per tph. Also, since the actual selected horsepower rating in most cases exceeds the calculated horsepower requirements, a diversity factor of 75 percent is frequently used by various plant builders.

Because the majority of drives encountered in the coal preparation plant fall below the 115-hp range, there is usually a large amount of 440-volt power required. Because the motor load is spread over a wide area, often involving several buildings, the load center unit substation is gaining wide acceptance as the best means of power distribution. There are several practices which determine the most economical size of load center unit, including: (1) primary feeder length; (2) secondary feeder length, and (3) substation size.

In the past several years there has been considerable activity in the direction of using load centers with wye connected secondaries and to ground the neutral of the 480-volt system, as contrasted to the old practice of using delta connected secondaries and leaving the system ungrounded. Because the majority of coal preparation plant load is from induction type motors which operate at a lagging power factor, the cost of improving power factor by means of capacitors generally can be repaid in a relatively short time by the saving on the power bill. In the over-all electrical design of the plant, due consideration should be given to the selection of power cables. In taking all factors into account, the point that should not be overlooked is the short circuit current which the cable must handle and the length of time that the short circuit current will flow before a protective device trips.

Henry F. Hebley, consulting engineer, Pittsburgh, Pa., discussed "Dust Collection in Coal Preparation Plants." Hebley pointed out that the impact of air pollution control is of growing concern to the coal industry as preparation plants get larger and thermal drying increases in favor. He examined presently available dust collection equipment and outlined results that can be expected under various conditions. As soon as the dust collection problem is solved, he concluded, the mine operator is faced with a problem of disposing of suspended solids.

MANAGEMENT AND COST CONTROLS

At a second Wednesday afternoon session, Management and Cost Controls were given a thorough study. E. M. Pace, general superintendent, Inland Steel Co., Wheelwright, Ky., was chairman of the session, and C. G. Evans, Personnel Manager, North American Coal Co., Cleveland, Ohio, was floor committeeman.

L. J. Prelaz, senior associate, Coal Standards, Inc., Mammoth, W. Va., in introducing his paper, "Positive Application of Industrial Engineering to Coal Mining," said that no cost control program can succeed unless it receives the full cooperation of all parties concerned. He then went on to describe how the Warner Collieries Co. used modern management techniques to reduce actual labor costs 28 percent, in the face of a rise in base wages of 86 percent, during the past eight years with a minimum of capitalization. During this period three mobile coal drills and three rubber-mounted cutting machines were the only capital purchases made.

In attacking the problem, the first approach was to briefly train supervisors and engineers on the theory of time study. A standard data system was adopted which involved a complete elemental breakdown of each face operation. These were time studied and then standards were determined. Detailed analyses of these standards have prompted changes in mining plans and methods to conform to seam conditions, equipment modifications, crew standardization, preventive maintenance practices, equipment concentration or disbursement, selection of new equipment, mainline haulage conversion, selection of materials, etc.

Prelaz concluded by saying standards, methods and cost control are but a few of the tools that have been designed and developed from management through industrial engineering. The method with which management applies these tools spells success or failure—an industrial engineering department can only function effectively when management gives its full support. Positive application of industrial engineering is not applied by the industrial engineering department, but through it, and the records on costs and production are the final proof of success or failure.

E. P. Bucklen, special engineer, Pocahontas Fuel Co., Pocahontas, Va., reported in a paper entitled, "Supply Cost Reduction by IBM Methods," that his company is in a position to make further worth-while savings in the cost of its supply system through the use of IBM equipment. While reports that are now being furnished Pocahontas Fuel management could be prepared manually, the cost would be much higher and the increased time lag would result in the loss of the reports, effectiveness, Bucklen said. IBM equipment can process tremendous quantities of data to produce the desired reports in a relatively short time. The time element is important as detail supply cost reports now can be provided management in a relatively short period of time, creating a foundation upon which to build a cost-reduction program. Not only do these reports make fixing of cost responsibility possible, but they disclose areas where action is necessary to stay within stated objectives.

Bucklen's highly informative paper is presented in full beginning on page 36 of this issue of *Mining Congress Journal*.

"An Industrial Engineer Looks at Cost Control" was the title of a paper by Earl L. Petersen, chief industrial engineer, Paul Weir Co., Chicago, Ill. Petersen said that, although the future of any individual coal company is bright, it is not guaranteed. The rewards of an expanding coal industry can only be earned competitively. Petersen went on to say that to stay in business there can be only one answer, there must be an ever-active, well defined program designed to exploit every available means to greater productivity at lower cost. Various forms of technical guidance are essential, but the real payoff is "are costs really being reduced?" He stressed the importance of a good attitude by all levels of the coal company organization. Mine foremen

cannot be expected to handle workers with confidence, respect, cooperation and trust unless all of their relations with management are also conducted with confidence, respect, cooperation and trust.

Today's worker can be more productive. He is mentally and physically superior to his predecessor yet, considering the use of improved tools and equipment, has his rate of production kept pace?

Quite often new or better equipment is assumed to be the only means of further cost reduction, but this is not always true. If the existing equipment is not being used to its full potential, there is little assurance that new equipment will be fully exploited.

Petersen went on to say that the importance of maintenance cannot be over-emphasized. In itself, good maintenance costs less than poor maintenance, yet the objective in any maintenance program should not be the cutting of maintenance costs alone. Anyone can cut maintenance cost—you only need to defer maintenance. Instead, there must be a program which includes plans to attain the level of maintenance consistent with the lowest possible product cost.

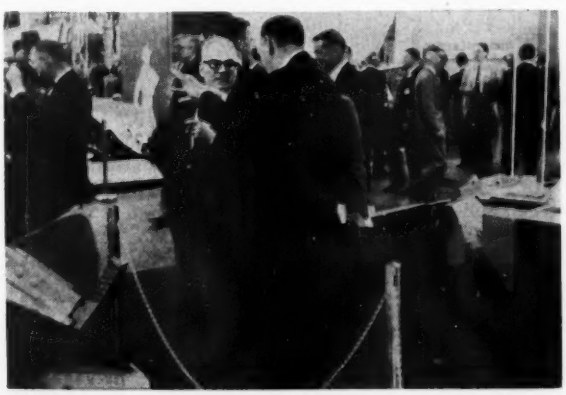
In conclusion, he said, the industrial engineer, with his training and applied means for obtaining helpful operational data, is often the most logical person to help the foreman develop the necessary supervisory skills to assure cost reduction.

Harry M. Tibbs, administrative assistant, Truax-Traer Coal Co., Kayford, W. Va., presented a paper on "Selection of Supervisors." Pointing out that this selection of supervision in underground coal mining is one of major concern and importance, Tibbs said that for all practical purposes the industry must depend upon individuals in the mines, or closely associated with the mines and community, for its supervisory personnel. He stressed the need for the impartial selection of supervisors and the desire to evaluate foreman performance. Although there is no known foolproof method of selecting supervisory personnel, if the industry uses all the tools that are now available, many of the mistakes that are now being made would be eliminated.

"Training Programs for Operators of New Equipment" was the title of the paper presented by Walter H. Fleming, supervisor of training, Tennessee Coal & Iron Division, U. S. Steel Corp., Fairfield, Ala.

The success or failure of any type of new equipment, jet airliner or modern coal loader, depends in a large measure on proper instruction given supervisors, maintenance men and operators. The effectiveness of this training can be measured by performance of the new equipment, Fleming said.

At TCI the instruction of operators in new equipment is handled by a five-man team consisting of a project engineer, two industrial engineers and two assistant mine formen. These men attend an instructional guidance course to learn the techniques of teaching and when new equipment is received, and before it is delivered to its place of operation, each member of the team becomes completely familiar with the construction and operation of the unit. Team members then give individual instruction to equipment operators, staying with the new operators until they are satisfied that the operator can be put on his own under normal supervision. Team members meet in conference frequently to talk over mutual problems and to work out improved procedures. TCI feels that from this basic program, miners may be taught to drive a team of oxen or to help a goat pull mine cars; or the program can be used to teach men to operate a self-controlled nuclear powered coal mining machine. Fleming emphasized the need to explain to a machine operator how his work fits in with the overall organization. The operator must understand that by increasing his productivity he will put his company in a better competitive position and that this in turn will add to his job security and better his own standard of living.



"This is how it works . . ."

LAND AND WATER USE

A joint luncheon meeting of the Land and Water Use Committees of the American Mining Congress and the National Coal Association was held on Wednesday, under the chairmanship of R. L. Iceland. A full agenda was disposed of as members discussed the problems of land use, water and air pollution and related problems in connection with mining.

EQUIPMENT MAINTENANCE

Equipment Maintenance was the subject of prime discussion at a session on Thursday morning, at which R. W. Fox, vice president, Production, The North American Coal Corp., Cleveland, Ohio, presided as chairman. C. C. Cornelius, United States Fuel Co., Salt Lake City, Utah, was floor committeeman.

A. R. Hood, superintendent, Warwick Mine, Duquesne Light Co., Greensboro, Pa., presented the first paper and discussed "Training Maintenance Personnel." Duquesne Light Co. established a formal training program for mechanics at its Warwick Mine to train maintenance personnel in trouble shooting electrical breakdowns at the working face. Courses were prepared by the master mechanic who had served eight years as an instructor in mining electrical vocational classes. The course instructor chosen had worked in the mine shops and as an underground mechanic for 12 years, had attended all vocational classes conducted by the master mechanic and possessed leadership qualities.

All shop and underground mechanics being trained worked eight weeks of steady day shift. During this time they attended two classes, each from three to four hours, every week. A minimum of 48 hours of instruction was obtained in this way. The course was opened with a short study of basic electricity, including Ohm's Law; characteristics of series and parallel circuits; and the proper use of meters and instruments. A limited time was spent in blackboard work, with more time being

spent on backing up each point with practical demonstrations and test equipment.

The cost of the training program, including classroom, classroom fixtures, necessary teaching implements, and wages was about $15,000. The company has no way of determining the monetary return on its investment, but maintenance supervisors who have followed the program closely are certain that the trained mechanics are more capable of coping with electrical troubles, that they approach such troubles with confidence, and that they seldom find it necessary to call for help.

C. B. Fulmer, superintendent, Power and Mechanical Department, Stonega Coke & Coal Co., Big Stone Gap, Va., also discussed "Training Maintenance Personnel." He said that in 1956 Stonega Coke & Coal Co. was faced with an acute shortage of men having the necessary training and experience in mining equipment maintenance. The company decided to start an extensive training program for new maintenance mechanics and electricians, and also to train those already employed. After the trainee was selected he was to go through a basic training period of 18 months and would then go to the mine as a maintenance mechanic where much of his training was gained in rebuilding equipment. It is estimated that a trainee receiving a training period of 18 months under the program as practiced at Stonega receives an education equivalent to at least six years of working as a mechanic on a mine section.

By using trainees in its equipment rebuilding program, Stonega adds a small amount to its rebuilding cost, but feels strongly that it is ahead of the game in that it has trained a mechanic. To date there have been eight trainees who have completed their basic training, and at this rate the company's requirements are being fulfilled.

"Maintenance of Continuous Mining Equipment at Federal No. 1 Mine" was the topic of a paper by William Laird, superintendent, Federal No. 1 Mine, Eastern Gas & Fuel Associates, Grant Town, W. Va. Eastern Gas & Fuel operates seven d-c power boring type continuous mining machines and one a-c power boring machine at its Federal No. 1 mine. Most of its production delays have been caused by grounding in the 100-hp bit motor, during failures on the 50-hp pump motor, bearing failures on the first three reduction gear shafts, hydraulic connections, bit replacement and bit holder replacement. By concentrating on each one of these trouble areas, in turn, down-time has been reduced. Laird went on to give a slide presentation showing the various stages of development in reengineering and redesigning component parts to improve machine performance.

"Preventive Maintenance in Low Coal" was the topic of a paper by Walter M. Crace, superintendent of Power & Maintenance, Princess Coals, Inc., Huntington, W. Va. At David, Ky., the Princess Elkhorn Coal Division of Princess Coals, Inc., operates in 29 to 33 in. of coal, highlighting the need for a better-than-average maintenance plan. One of the first needs to be met was to solve the short supply of skilled manpower for a good maintenance program. As a first step a 2400 to 3200-hour course of shop practice in machine work was established in cooperation with the Mayo State Vocational School.

In conjunction with the Mayo program, the company started training classes on the job to improve its mechanics. Two-hour classes were held twice weekly for ten weeks. Refresher courses in hydraulics, panel wiring, lubrication, bearing maintenance and gear fits were taught.

By 1956 the company felt it had the trained personnel needed for a successful maintenance program, and a unit change-out system of preventive maintenance was inaugurated. Through conferences with maintenance supervisors and industrial engineers, it was determined how many complete units on face equipment could be changed out underground. Approximately 70 unit assemblies were decided on. Most of these were on three pieces of equipment; loading machine, shuttle car and cutting machine. The life expectancy or change cycle on all unit assemblies was set by the maintenance supervisors from records available and from experience. As experience dictates, revision is made to the schedules, both as to the units to be included and the frequency of change-out.

The workload for the maintenance organization is carefully scheduled. Particular care is taken to see that third-shift maintenance supervisors underground are not overloaded. The most important change-out work is done on this shift, and hasty work is costly.

W. R. Wood, electrical superintendent, and P. C. Stull, supervisor of maintenance, The Berwind-White Coal Mining Co., Windber, Pa., coauthored the next paper entitled, "Overhauling Mining Equipment." It was presented by Wood, who told how Berwind-White Coal Mining Co. is developing its overhaul program at mines located in Cambria County, Pa.

In accordance with the company's planned overhaul program as carried out over the past year, an overhaul job is a complete overhaul. The machine is completely disassembled, as are component parts. Every part is checked for wear and physical damage. The maintenance supervisor decides how each part shall be restored to condition equivalent to new, so far as serviceability is concerned.

Wood also pointed out that the company over the years has provided training for the mine mechanics. In years gone by this took the form of strictly practical job training in electric motor and manual control maintenance. With the advent of magnetic controls and hydraulic equipped machines, it has been necessary to augment shop training with classroom instruction covering electric wiring diagrams, and hydraulic circuit functions and diagrams as well as other details. This phase of training is now being carried out by the mechanical foreman at each mine, supplemented by visits to the central shop when pertinent items of equipment are disassembled for overhaul.

After due consideration of all costs chargeable to the overhaul shop, the coal company finds its overhaul costs somewhat less than could be had from outside shops for comparable jobs, besides saving considerable travel time and expense of conferences and inspections at the contracting shop, Wood added. He pointed out that this desirable situation may not be relized by other mine shops due to amount of overhaul work to be done, location or other factors.

THIN SEAM MINING

Final session of the 1959 Coal Show was one on Thin Seam Mining and was held Thursday afternoon. Joe L. McQuade, president, Donegan Coal & Coke Co., Richwood, W. Va., was chairman of the session and David Zeeger, Division Superintendent, Elkhorn Division, Bethlehem Mines Corp., Jenkins, Ky., was floor committeeman.

Victor L. Hurley, president, Cedar Creek Mining Co., presented the first paper, entitled, "Continuous Mining in Thin Seams." Hurley based his paper on Crichton Coal & Coke Company's experience with haulage be-

hind continuous mining equipment in thin seams. The company is using a system of face haulage which involves an extensible belt conveyor having sufficient side reach to allow the driving of multiple entries from one heading. In addition to describing the operation, Hurley analyzed the results that have accrued from the use of this system.

"Conventional Mining in Thin Seams" was the title of the next paper and was presented by James D. Carter, mine superintendent, Osborne Mining Corp., Williamson, W. Va. Carter described how Osborne Mining Corp. has improved efficiency by increasing the tonnage prepared per working place, installing large capacity elevators at loading points, altering mine projections and establishing a definite pattern for the movement of equipment at the face.

In January of this year Warner Collieries Co. installed a chain feeder at its Jensie Mine in Ohio, which paid for itself in three months by increasing section productivity, reported Myron Kok, vice president, The Warner Collieries Co., Mammoth, W. Va., in his paper, "Improving Production With a Newly Designed Transfer Feeder." A double, converging chain feeder, the unit increased section production 6.5 percent on the advance and 6.4 percent on the retreat. The feeder is 23 ft long, 30 in. wide at the throat or discharge end and 8 ft 6 in. wide at the shuttle car loading end. It weighs 5500 lb and is powered by a 10-hp motor. Chain speeds on the feeder, which is 32 in. high, can be varied from 70 to 90 fpm. The feeder has a wide, high capacity conveyor at the intake end and converges to a narrow, lower capacity conveyor at the discharge end. It provides the necessary high intake capacity at volume for temporary storage of coal in the hopper, and a narrow, low rate of discharge for good belt loading.

Kok's complete paper appears on pages *55* to *60* of this issue of *Mining Congress Journal.*

"Roof Control in Thin Seams" was the subject of a paper by Stonie Barker, Jr., mine superintendent, Island Creek Coal Co., Wyoming, W. Va. Barker said that Island Creek Coal Co. has had trouble with roof support at its mine in the No. 3 Elkhorn seam in Breathitt County, Ky. The coal, which averages 30 to 34 in. high, is overlaid with laminated layers of slate and shale. Main entries are driven 28 ft wide, but panel entries are driven 30 ft wide and rooms are driven up to 55 ft wide—the average being 45 ft. A row of 30-in. roof bolts is installed across the working face, every cut, on a five-ft spacing. In addition, a 60-in bolt is placed in the center of the place, midway between rows. It appears that the key to the success of the present timbering system is the 60-in. bolt.

In addition to roof bolts, permanent timbers are set to within 1½ cuts of the face. These consist of wood posts and cap pieces set on four-ft centers within two ft of the ribs, with a 12-ft roadway being left in the middle of the place. In all, approximately 20 posts are set in rooms and 14 are placed in entry work per cut.

Tom N. Shattuck, mine superintendent, Wind Rock Coal & Coke Co., Oliver Springs, Tenn., presented a paper entitled "Underground augering Under Difficult Seam Conditions." Shattuck said that recently Wind Rock Coal & Coke Co. was faced with the fact that it could no longer mine coal at its property near Oliver Springs, Tenn., in competition with other suppliers to TVA. It was then decided to buy a coal auger for use underground. The unit that was selected came in two parts, a power unit and an auger unit. This arrangement kept the size of the machine at a minimum, allowing maximum maneuverability within the mine.

The auger head barrel is 34 in. in diameter and the head rotates at speeds of up to 35 rpm. The auger unit is maneuvered by four jacks. The bottom jacks will raise the auger unit 36 in., making it possible to position the machine at any height of inclination. Two roof jacks at the rear of the machine anchor the unit.

The power unit is skid-mounted, carries two 50-hp motors and a 250-gal hydraulic storage tank, from which all movements of both units secure their power.

Just now going into operation, the auger will be used to bore 100-ft deep holes, leaving a six-in. pillar between holes. One side of a set of auger entries will be mined on the advance, and the other side on the retreat. A 100-ft barrier pillar will be left to protect the main haulage entries.

Wind Rock Coal & Coke believes that auger mining will enable a profitable recovery of coal from areas which had been uneconomical to mine by other methods.

FUN AND RELAXATION

On Wednesday night the Coal Miners Party was held in three sections, one each at the Carter, Statler, and Sheraton-Cleveland Hotels. An outstanding evening, including dining, dancing and an especially entertaining floor show was enjoyed by the large mining crowd.

Ladies attending the Coal Show enjoyed special events that had been planned in their honor. These included a luncheon in the Lounge of Halle Brothers department store, where the ladies viewed a presentation of the latest in style and fashion. The following day, Tuesday, a luncheon was held at the beautiful Westwood Country Club. Following the luncheon, Mrs. Herbert H. Greger, internationally known author and floral designer, presented an interesting demonstration of floral arrangements.

The Fashion Luncheon Monday was one of the events planned in honor of the ladies

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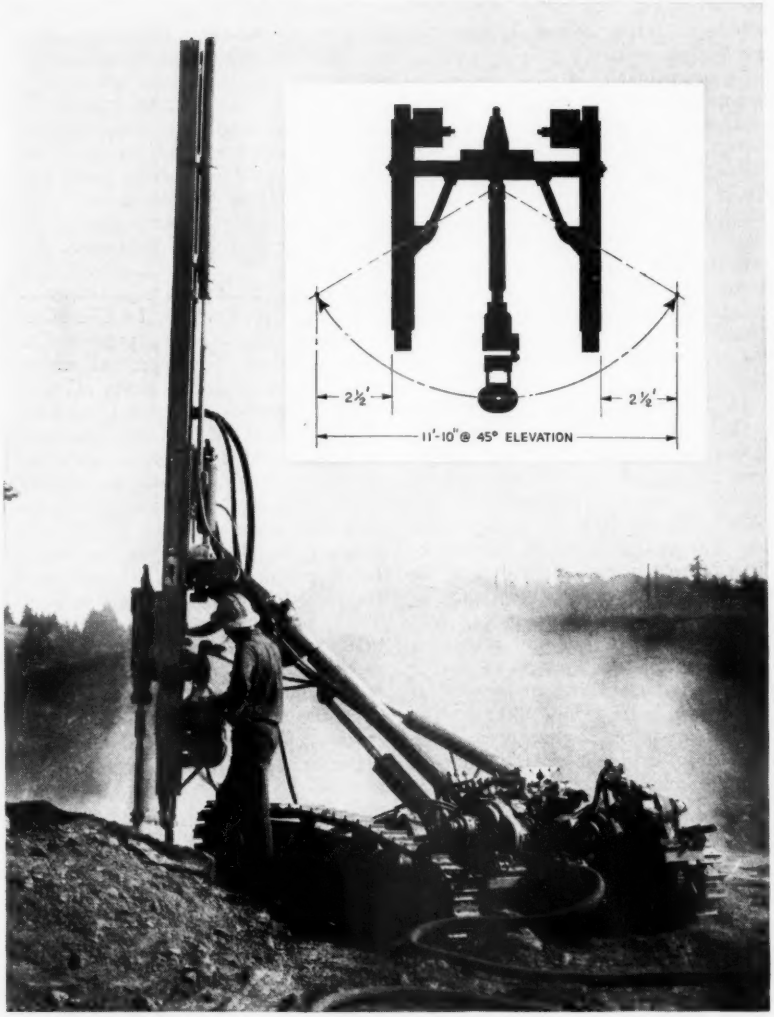

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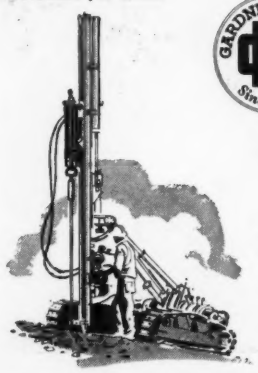

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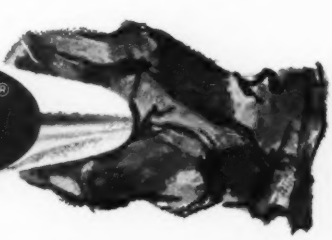

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New Trends in PLANT DESIGN

Design, construction, and operation of a modern metallurgical plant requires painstaking investigation of all related factors. In these days of high costs, and often low market prices, a plant which is uneconomically designed may be hopelessly handicapped in its struggle against competition

Fig. 1. Automation is becoming a by-word in all types of plant design. Whereas at one time the remark, "This operation won't justify automatic controls," was frequently heard, it is now difficult to justify an operation without automatic controls. Shown is a console-type motor control center which allows operators in a smelter to follow the sequence of operations and see at a glance whether or not each unit is running

WHILE there has been no spectacular breakthrough causing radical changes in metallurgical plant design in the past few years, many changes have been brought about through constant evolution—both technologic and economic, and they have a large cumulative effect.

Both in new construction and in plant improvements, the trend of management is toward more critical analyses and studies of plant capital and operating costs. A plant which is uneconomically designed may be hopelessly handicapped in its struggle against competition. Advancing technology in the minerals and metallurgical fields is introducing new product standards which were impossible a few years ago, and these bring early obsolescence.

The process, design and construction engineers' ingenuity is often taxed in applying new technology, machines and construction methods to solving specific problems and anticipating expansion and flexibility.

Reduction in capital and operating costs, uniformity of products and improvement in quality are possible through improved plant design resulting from a combination of engineering studies and profitability analyses.

It is the purpose of this paper to consider certain of the new trends and techniques in plant design and their relationship to plant costs. The improvements are so many and varied that it is possible to touch only on highlights of specific applications in illustrating these trends.

By

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and

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Design Trends and Factors Affecting Capital Costs

In fundamental planning, the process engineer is being called upon

more and more to prepare not only the plant flowsheet and material balances, but also to present data pointing out the economic feasibility of the program in terms of operating costs and profitability analyses.

Detailed flowsheets: With the increasing complexity of the modern plants, there is a definite trend toward more complete and detailed process flowsheets, block diagrams and piping and instrumentation diagrams. Not only do these serve in the selection of optimum control and operation methods, but they assist in evaluating or confirming the economics of a project, and making a graphic presentation to management. Where the practical feasibility of a project may be taken as established, or in cases where management presents the engineer with a "fait accompli" regarding plant size, process and type of product, there still remains much work to be done in analyzing the steps of the process in light of new technology or possible alternatives which may have attractive capital and operating cost savings.

Use of computors: Mechanical and electrical computation is becoming increasingly important in solving many of the complex problems in process comparisons. A recent uranium plant design required a series of computations of process equilibrium conditions and recoveries with various stages of extraction. These were solved rapidly with electronic computors, saving much valuable engineering time. Problems in heat transfer, process control, thermodynamics and ion exchange performance, to name but a few being encountered in this industry, are capable of machine solution.

Whether a company owns or rents computors, uses them in conjunction with their accounting system, or engages them on a contract basis, management is becoming increasingly aware that savings by their use may be effected in engineering costs, and process evaluations facilitated.

In order that the comparisons of improvements or process alternatives be significant, it is necessary that practical and reliable rapid cost estimates be made. Many timely articles have been presented in the past few years covering correlation and standardization of cost data and cost analyses of the preliminary or pre-design type, and the use of these is increasing. Where the results of process evaluation and of capital cost analyses can be converted rapidly on standard forms into operating costs and profitability analyses, the comparisons form the basis for the trend in improved basic design and early management approval. Changes and design improvements in flowsheets can much more easily be brought about as knowledge is gained and the incentives are demonstrated.

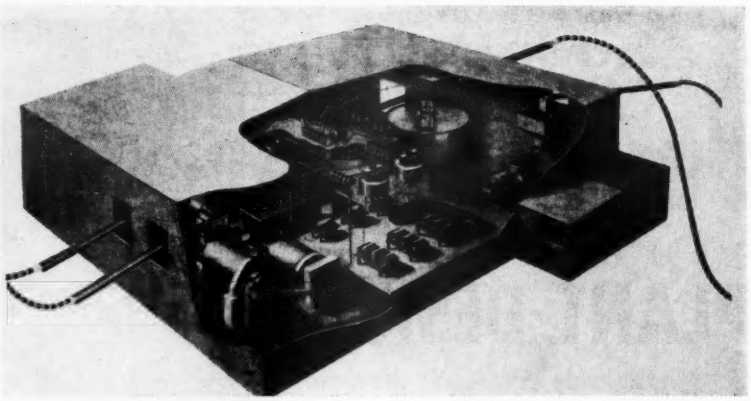

Fig. 2. Where models are not feasible due to the size of the project or time limitations, the artist's perspective, based on preliminary or cutout studies, is a valuable aid in preparing and analyzing layouts. Shown is a typical perspective which illustrates the filtering section of a new plant

Scale models: A second trend in basic planning of plant layouts is the preparation of scale models. These models are of great aid in preventing interferences between the piping, structural, electrical and other design groups. Location of control centers, panels, stairs and walkways for ease of operation is facilitated. After plant planning and construction, the model can serve as a useful tool in operator training.

Where models are not feasible due to the size of the project or time limitations, the artist's perspective, based on preliminary or cutout studies, is a valuable aid in preparing and analyzing layouts. Frequently, operator figures are added for realism. A typical perspective is shown in figure 2.

Safety: A third point which has been receiving more attention in the basic planning stages is safety, as it influences the development of the plot plan and the selection and location of plant and personnel protective devices. Similarly, an early recommendation by insurance carriers on fire and other protection systems pays off in lower insurance premiums.

Plant planners are paying more attention to employee comfort and morale. Control rooms are being air conditioned, lunch room facilities are more convenient to the working areas, and change houses with modern shower and locker facilities are being provided. First aid rooms are practically a "must" in larger plants. Even the location of the parking lot has assumed a place of importance.

Although the returns from increased safety and employee comfort may be intangible, management acceptance indicates a recognition of their value in successful plant operation.

Chemical versus physical processes: The technology trend in metallurgical plant design which is attracting much interest today is the substitution of predominantly chemical for physical processes in the metallurgical practice. The search for lower costs has initiated probing of chemical processes for advanced technology. A specific recent example is the application of ion exchange—formerly a laboratory tool frequently used in water treatment, but now of importance in the recovery of uranium, vanadium, cobalt, tungsten and many other rare metals and earths.

Column ion exchange, resin-in-pulp (basket ion exchange) and solvent extraction (liquid ion exchange) offer advantages or potentials in continuity of operation, versatility, selective action, ease of control, lower reagent inventories, and reduced space requirements. All these advantages result in decreased capital and operating costs.

The adaptation of chemical and petroleum processes to the metallurgical field is certain to increase.

Improved chemical reagents have also aided the designer and made possible the handling of ores which only a few years ago would have been difficult and costly. For example, the new flocculating agents have materially reduced thickener sizes and improved filtration rates of slimy pulps. A recent plant design indicated that set-

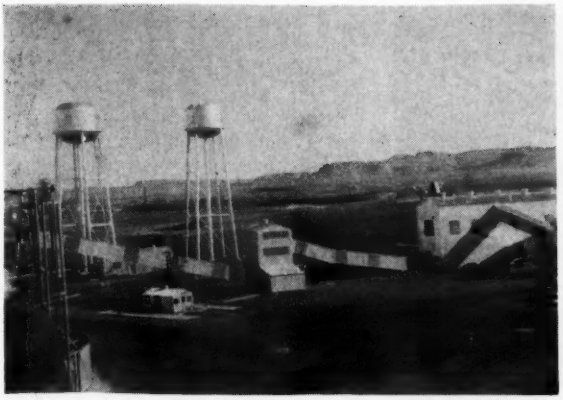

Fig. 3. Horizontal plant design (above) compared with vertical design (below). Horizontal arrangement permits a wider latitude in expansion and greater flexibility

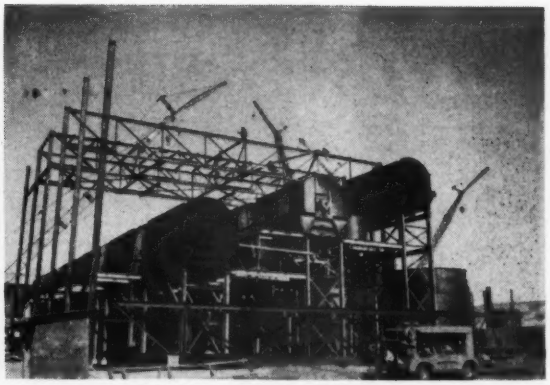

Fig. 4. Noteworthy savings were realized in construction of this plant by installing practically all of the heavy equipment before erection and closing of the building structure

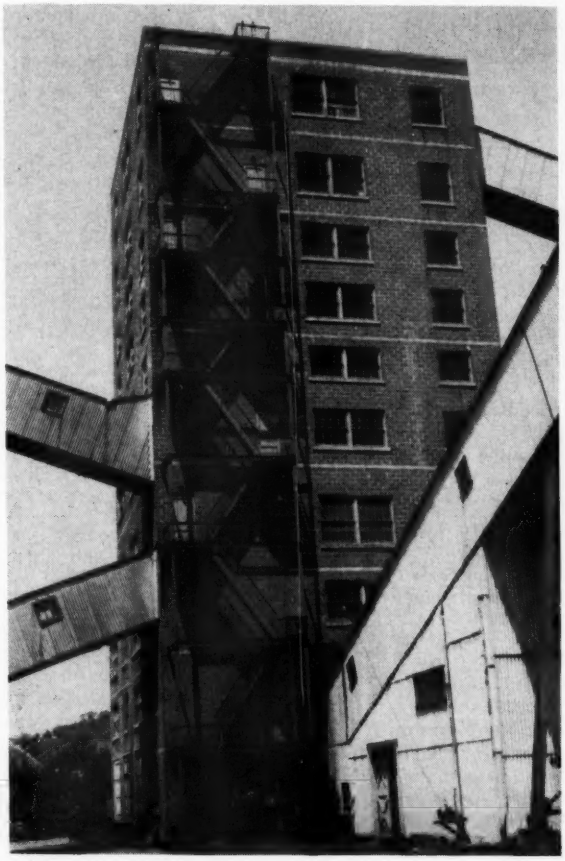

Fig. 5. Package boiler plants are being designed for outdoor use with only the central control panel or console housed. Pictured is an outdoor boiler plant with carbonation towers in the background

tling areas could be reduced to one third those first calculated, resulting in significant capital cost savings.

Chelating agents, modifying agents, protective colloids, etc., are now common terms in the industry and the concept of "chemical metallurgy" is winning new adherents.

In the field of mechanical equipment, a significant development is the use of the cyclone. For dewatering, attrition and classification, the liquid cyclone has been finding increased acceptance.

The centrifugal classifier (cyclone) using air is also finding applications in the separation of impurities from ores; low power consumption being an advantage. Heavy media, high intensity magnetic and electrostatic separator techniques have been improved significantly in the past few years.

Materials of construction: Materials have come in for much attention. Stainless steel applications are well known, but there appears to be a trend toward the use of titanium, zirconium, tantalum and their alloys for use in the unusual chemical-metallurgical process.

Ceramic materials and tungsten carbides have proved valuable in cyclone apex valves, reducing valves and other applications where heavy abrasion has been significant.

To minimize replacement costs, eliminate galvanic corrosion problems and reduce field construction costs, the use of plastics is increasing. Improvements have made the material easy to install and its light weight makes it easy to handle. Polyvinylchloride (PVC) pipe was installed in a recently constructed metallurgical plant. Experience to date has been

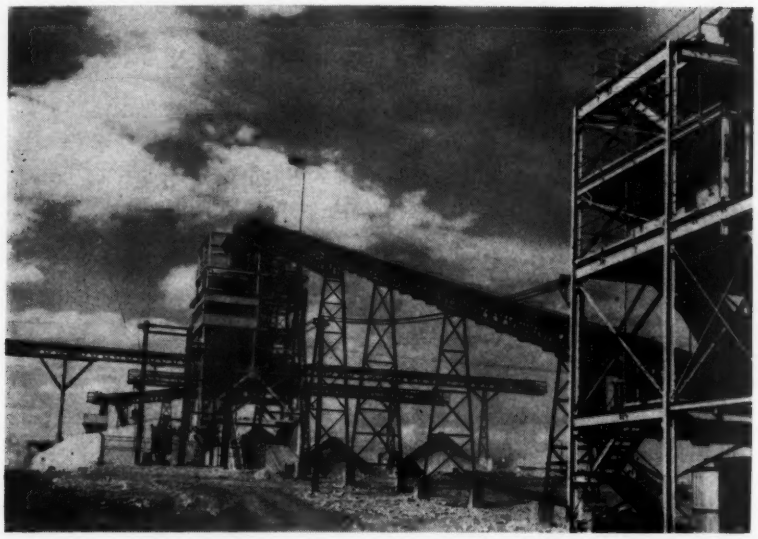

Fig. 6. One-man centralized control is a definite trend. Here is an aggregate plant screening tower with a control center on the fifth level

good in several installations, with little evidence of failure over a considerable operation period.

Economic analyses comparing initial cost, life expectancy and consideration of the advantages to be gained by using these materials are the prime factors dictating their selection.

Planning for the future: It frequently happens that a plant as originally constructed must be modified or enlarged from time to time to meet the needs of changing ores or changing markets. Occasionally a scale-up from limited pilot plant data does not permit a valid prediction of performance under production conditions. Custom ores frequently introduce more than their share of problems.

Present design trends are toward critical examination of plant layouts for symmetry and the possibilities of future installation of additional units; "Open-end" layout is being recognized. With this design provision, if properly planned, expansion and operational flexibility can be readily incorporated when the need arises.

An example of a design trend of the past twenty years which has aided expansion and flexibility is the spreading out of plants horizontally rather than vertically. Figure 3 (below) shows a typical crushed stone plant of the old vertical type. It was compact with few conveyors and these very short. Bucket elevators were commonly used. Overall maintenance was high. As product demand increased and wage rates rose, the vertical plants have been supplemented by more modern designs.

In contrast, figure 3 (above) shows a plant with practically the same flowsheet as the plant below, but strung out horizontally. Conveyors are long, but not excessive and the arrangement permits much latitude in expansion and flexibility.

Equipment selection anticipates certain of the expansion and flexibility problems by the application of V-belt or vari-speed drives on critical pumps, fans, conveyors and other equipment.

Instrumentation and centralized control also add greatly to the flexibility of the new plants by permitting rapid and accurate changes of process conditions to meet changing ore analyses or product specifications.

Zoning laws are becoming more of a problem to the plant designer. Not only must he be aware of current regulations in an area, but he must anticipate possible future regulations which may be brought about through adjacent area laws. A case in point are those areas surrounding Los Angeles County which are now adopting the pollution codes of that county.

Noise and dust control: The well-planned plants are including provisions to reduce noise and abate fumes, dusts and odors.

The disposal of industrial wastes to prevent pollution of water sheds is frequently a problem and extended tests of soil conditions, including drillings, permeability tests, etc., must be accomplished.

There is a definite trend today for Public Health Service economists, engineers, Federal Agencies and other groups in developing data based on economic principles to demonstrate what pollution can cost in a local area or region, and what expenditures can be economically justified for its control. There are intangible benefits to be recognized, as good community relations can be as vital and profitable as increased production.

In the plant itself, the increased worker comfort, reduction of maintenance and savings in product losses can be evaluated to offer a firm basis for positive management action on an aggressive anti-noise and pollution policy.

Fig. 7. Heat recovery systems are receiving increasing attention. Economy and improved control resulted from this installation which interchanges heat between slurries and extraction solutions at a uranium plant

Construction Factors Affecting Capital Costs

In the construction field increased attention is being given to prior planning, scheduling and construction practices which insure that the plant will be finished in the allotted time and within the budget. There is

greater recognition of the value of liaison engineers, both in the engineering office and in the field, to expedite decisions, minimize misunderstandings and frequently to assist in plant start-up.

A recent example of a construction practice which resulted in noteworthy savings is shown in figure 4. In this plant practically all the heavy equipment was installed before erection and closing of the building structure. Cranes moved freely through the area and rigging and interferences were substantially reduced.

Following the lead of the petroleum industry, there is an increasing trend toward outdoor construction where weather conditions, materials, or the types of equipment permit.

Starting at the plant stockpile, the trend is toward open storages with the counter ports on the outside, thereby leaving the inside free from all obstruction and giving maximum storage capacity and ready access to all parts. Reclaiming tunnels of the corrugated metal type are becoming increasingly popular. Wheeled front-end loaders have been displacing shovels and dozers in reclaiming.

Conveyor galleries have been diminished in size until there is little more than a walkway and a removable corrugated cover over the belt itself .

Boiler plants of the package type are being designed for outdoor use with only the central control panel or console housed. A typical recently installed automatic package boiler facility and carbonation plant is illustrated in figure 5. The carbonation transfer pumps and manifolds, all insulated, are located outside in an area where zero temperatures are expected. Lower costs and improved accessibility have resulted from these outdoor design practices.

Design Trends Affecting Operating Costs

A review of those design trends affecting operating costs indicate that major efforts have been centered about manpower savings.

Centralized control: One-man centralized control is a definite trend. Figure 6 shows an aggregate plant screening tower with a control center on the fifth level. A good view of all operations is permitted by this arrangement. Operating consoles are located in the plant control center. One is for the conveyors and crushing plant up to the surge pile and another is for finishing and load out. Controls located on a panel behind the consoles regulate the electromagnetic feeders used to blend on to the stockpile. This particular installation is set up so as many as 12 feeders can be utilized on a complex aggregate specification with a range of 2½ to ¼ inch. The feeder controls are calibrated in such a manner as to utilize the maximum capacity of the recovery blending belt. It does away with the haphazard opening of gates manually and depending on a man's guess as to the proportion of the particular size desired.

The electrical control facilities of this plant are not complex in themselves, but are designed and arranged for the maximum in efficiency while at the same time retaining the simplicity for proper operation.

Because of the varying specifications, this plant uses a group of ten overhead bins of 100-ton capacity each, thus enabling trucks and railroad cars to be loaded in a minimum of time. In one specific instance, this plant furnished 8000 tons of carefully blended material covering a range of eleven separate specification changes. Such a setup allows a plant to furnish any required specification at a moment's notice, in a single truck-load or in carload lots.

Centralized control is typified in a uranium plant where from a semi-graphically arranged panel, all the process valves on a series of tanks covering a block 50 ft wide by 200 ft long and 60 ft high may be remotely operated by one man. Critical data are recorded and automatic control insures close adherence to preset conditions, thus insuring the efficiency and economy of the process. Centralized motor control (see figure 1) allows operators to follow the sequence of operations and see at a glance that each unit is running. Graphic and semi-graphic motor control panels minimize the training necessary for operators and avoid errors in start-up.

Motor starting panels with sequence controls and interlocks materially reduce start-up and shut-down times. Where production interruptions due to plug-ins, starvation, or other malfunctions occur, the time of cleanup and restarting can be minimized where alarms advise the operator promptly and the machines are interlocked and shut down in proper sequence.

Automation: Automation is becoming a by-word in all types of plant design. Whereas the remark, "This operation won't justify automatic controls," was frequently heard, it is now difficult to justify an operation without automatic control. With the metallurgical field being entered by refining companies where automatic controls have been perfected to a high degree, there will be added stimulus to this trend.

Automatic control prevents the errors which result from manual operation, and also with control processes which by their very nature are not capable of being controlled by hand. This releases personnel to attend to more important duties.

Use of installed automation is not always practicable on start-up. Time is required to identify process variables, measure them, and understand those that are significant. This calls for adequate accurate measuring equipment, strategically located, with careful attention by process engineers during start-up. The design must provide that the automatic controls can be cut in and out of the circuits as required.

The trend in design is towards miniature instruments, standard instrumentation and automation, graphic and semi-graphic panels and more complete alarm and indicating systems.

Critical cost analyses are indicated to curb tendencies for over-engineering and to prevent the installation of controls which are too complex for operators and maintenance personnel.

Job consolidation: Another opportunity for operating cost savings is strategically located man lifts. Where consolidation of jobs by the use of a man lift can eliminate one man per shift, the payout period is generally about two to three years for an ordinary two-floor lift.

Closed circuit television will frequently eliminate a man and yet insure continuity of operation. Critical points such as chutes, trippers and the ends of shuttle belts where chokeups are possible may be viewed on a receiving screen at the control center. Selector switches enable the operator to monitor each critical point at will. An analysis of a two or three-camera installation with one receiver indicates possible payouts of two to three years based on manpower savings.

The study of the sequence of operations and the development of an operating manual is frequently the responsibility of the plant designers, assisted by the operators. Here an awareness of operating problems and an appreciation of the importance of the proper location of classes of equipment as a means of anticipating future manpower savings is empha sized.

Management has an increasing consciousness of the importance of job analyses and possible classifications

which will result in minimum manpower and leave the way clear for future consolidation of classifications without undue difficulties.

Plant utilities: Plant utilities are coming in for their share of attention as a fertile ground to achieve operating savings. There is an increasing tendency to meter (and thus control) electricity, water, steam and air to various plant sections and itemize these accounts on the cost sheets each month. Trends and significant deviations can be analyzed and timely action taken to prevent losses.

Recovery systems for heat are receiving increasing attention in metallurgical plants. Interchange of heat between outgoing and incoming streams is illustrated in figure 7. Significant economy as well as improved control resulted from this installation.

There is increased interest in waste heat boilers as a source of process steam. Installations on kilns and furnaces are becoming more common and designs for future heat recovery systems which will be economical as fuel values increase are being considered. Water re-use, including recycling of tailings has received much study in those areas where there are serious water problems. Efforts to insure efficient use of water, or to substitute air cooling for water cooling has been significant in the industry.

Provisions for maintenance: There is an increasing awareness among designers, operators and management that every component of a system is important due to the continuous nature of many processes, and that where there is wear, there is maintenance. A recent trend is to have the maintenance superintendent, as well as the plant operator, approve design drawings to insure that locations and clearances for easy maintenance are maintained. In engineering design groups, the same effect is achieved by reviews of layouts by experienced operations personnel.

Simplification for systematized maintenance includes the following design considerations:

1. Ease of periodic inspection
2. Provisions for accessibility with fork lift trucks, boom trucks or overhead cranes during repairs or replacement
3. Choice of equipment designed for easy installation and maintenance
4. Centralized lubrication systems
5. Adequate standbys
6. Standardization of components wherever possible
7. Preparation of spare parts lists by the designer and equipment vendor at the time of purchase

Standardization also facilitates rapid replacement of components and minimizes field stripping time for repairs. Spare parts inventories are reduced and shop time kept to a minimum where routine repairs or replacements are normal.

The design of shops for maintenance has undergone close scrutiny, particularly in the provision of adequate office space for personnel, card records and the paper work system.

Where adequate records are kept and the value of product dollars lost, idle time, fixed overhead, parts and overtime are considered, the incentive for attention to design for maintenance becomes apparent.

Laboratories: A recent trend in metallurgical laboratories appears to be in the direction of centralization, particularly where control and analytical procedures and correlation of data are facilitated.

Special provisions must also be made for the advanced analytical equipment now necessary in many metallurgical laboratories. Units previously associated primarily with research; such as, polarographs, spectrophotometers, fluorimeters, to name a few, require special housing and utilities generally not available in a control laboratory.

Adequately designed, air conditioned laboratories with adequate equipment help to attract suitable, qualified personnel. Generally, the case for centralized analytical control and special equipment may easily be made on an economic evaluation.

A second type of testing facility becoming of increasing interest is the "process" or, in uranium, the "amenability" laboratory. This laboratory will contain complete miniature processing equipment for crushing, grinding, extraction, filtering, purification and other unit processes contained in the main plant cycle. Occasionally, a pilot plant section with automatic control will be included.

For supervision of processes or anticipating of process changes as required by varying custom ores, the process laboratory has proved invaluable.

In conclusion, the metallurgical industry is acutely conscious of the possibilities inherent in technical advances. The new trends and advances constitute a major hope for continued prosperity under conditions of more difficult competition, more precise specifications and increasing costs. The incentive for better engineering and the trend toward improved technology is acutely reflected in management's critical evaluation of industry's capital and operating costs.

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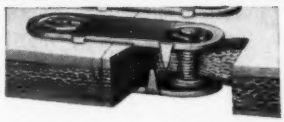

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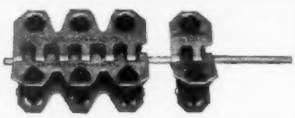

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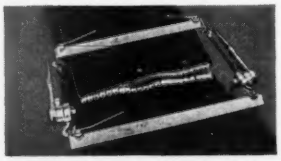

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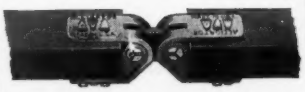

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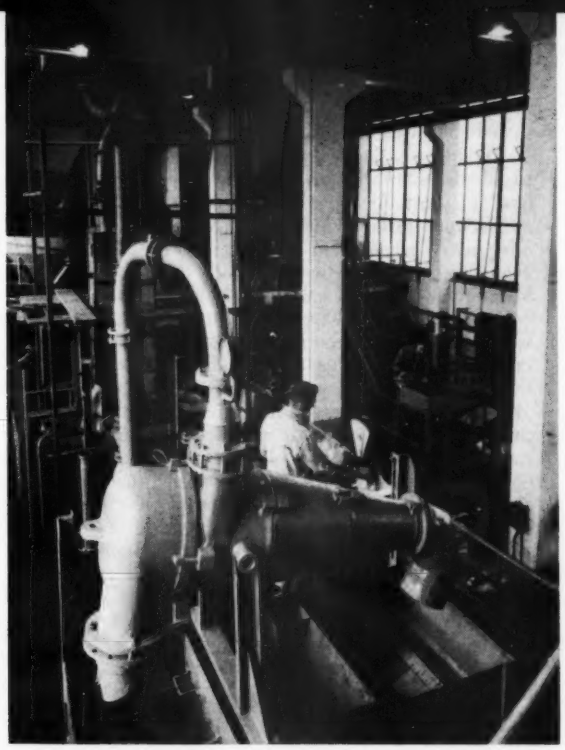
PART II:

The Dutch State Mines Heavy Medium Cyclone Washing System



Part of the facilities of the Dutch State Mines' Mining Research Establishment for experiments on coal preparation systems and equipment. Note the 500-mm heavy medium testing cyclone in the foreground

In the second part of his discussion of heavy medium cyclone cleaning, Dr. Krijgsman predicts results in cleaning six typical American coals with heavy medium cyclones

By

DR. C. KRIJGSMAN

Chef Centrale Dienst Wasserijen Staatsmijnen in Limburg Hoensbroek-Treebeek, Netherlands

Impact of System Upon U. S. Coal Industry

For the treatment of iron ore, the cyclone washer is widely applied in the United States[11,15] and has proven successful. However, so far no such installation has been used in the U. S. coal industry. Within the last 20 years, coal mining in the United States has rapidly changed from selective hand mining methods to a highly mechanized science. The progressingly higher cost of labor coupled with increased working of lower quantity seams have forced the coal producer to go to the most advanced mechanized mining systems in order to survive. Coal requirements, too, have changed to the point where sales of lump and egg sized coals are largely dependent upon shrinking seasonal demands. Market conditions have changed, practically hand-in-hand, with the need to produce more coal at a lower per-ton cost. This tremendous American industrial expansion of the past few years has thrown an increasingly heavier load upon preparation plants, while at the same time full seam mechanical mining is producing smaller sized and harder-to-clean raw coals. The custom of buying coal by weight has given way to purchasing on an energy unit basis, with a vast number of sales contracts incorporating penalty clauses for falling below a specified Btu scale. More specialized steels and alloys are demanding consistently lower sulphur coals, calling for cleaning requirements virtually impossible to meet with most of our present fine coal washing equipment.

Another aspect pertaining to the above that has become quite serious is the fact that the preparation engineer is placed in a position where he has to clean at lower specific gravities in order to sell his fine coal. When he does this, cleaning efficiency drops and more recoverable coal is lost with the rejects. Because this material is lost forever, it is readily seen that such losses of a 100 tph fine coal feed would reflect a tremendous monetary gain if this material could be placed in the railroad car rather than on the refuse heap. There are many plants that are throwing away as much as 25 percent of their available fine coal merely by trying to clean at lower gravities than their present equipment can economically handle. As pointed out above, fine coal can be cleaned in the Dutch State Mines heavy medium cyclone washer at any specific gravity from 1.30, if necessary, on up and at the same time make an extremely sharp separation at any gravity required.

The conditions mentioned undoubtedly will grow worse in the future. The very fact that the better seams are rapidly being exhausted will, in itself, force the coal operator to mine lower grade coals, and if he is to survive, he will have to clean those coals to more exacting specifications than ever before. In addition to this, past selective mining methods have left large areas of unmined coal simply because this coal has contained enough near-gravity reject material to render it unfit for cleaning with equipment that could only wash to the 1.60 specific gravity range. Most of this coal was left when undercutting and shooting methods pro-

duced coal with a minimum of minus ¾ in. in size. Consider the washing problems that will arise when this coal is eventually recovered by using continuous mining machines. Actually, many preparation engineers are even now struggling unsuccessfully to lower their fine coal ash and sulphur content with antiquated equipment, while at the same time receiving ever larger amounts of this material from their mines. When rash and near-gravity bony are present in the coal, the operator is forced to a scalping procedure in order to sell his fine coal. This is true of air cleaning, wet tables, jigs, and other methods now used in America. In a great number of cases, even this wasteful system is not successful, because the near-gravity high ash material can go either way, sometimes with the clean coal and sometimes with the refuse, and this is what creates the frustrating experience of producing an acceptable coal one hour and a high ash product the next. As pointed out above, this will not occur in a cyclone washer where the specific gravity of separation remains very constant.

Present iron ore production being based upon pelletized domestic and high grade imported ores calls for maximum blast furnace efficiency. It is no longer acceptable to depend upon slagging off large quantities of sulphur and ash in the flux.

In the accompanying tables (IV to X), the author has computed the specific gravity necessary to wash various difficult-to-clean seams in different areas of the United States. You will note that the heavy medium cyclone will not only clean these coals, but will do so with a remarkably high degree of efficiency regardless of the specific gravity used, and as long as the feed tonnage to the cyclone is not exceeded (up to 50 tph for a 20-in. diameter cyclone), wide variations in amounts of rejects will not affect the cleaning efficiency.

Typical American Coal and Predicted Results

The calculated results to be obtained with the aid of a cyclone washer are based on the experience gained with all the different cyclone washer plants now in operation in Europe.

As a matter of interest column *e* of example 1 (table IV) has also been included in table V, this column being the refuse of the Miller B seam from a cyclone washer. This data should be compared with column b (table V), the refuse of the same seam, but from a dry cleaning table. The refuse of the cyclone washer contains only 7.61 percent minus 1.35 material against 53.3 percent for the refuse of the dry cleaning plant. Furthermore, the quantity of the refuse of the dry cleaning plant is probably about twice as much due to the great amount of low gravity material in the refuse so that the actual losses are not seven times, but probably 14 times as much!

In table X a summary is given of the calculated results which can be obtained with a cyclone washer installation. For all the six examples the ash difference, i.e. the difference of the theoretical ash of the clean coal at the obtained yield and the actually-obtained ash at the same yield, is low.

Table IV

Example No. 1
¾ inch by 35 mesh raw coal--Miller B seam—Pennsylvania
ash raw coal: 11.25%
required ash clean coal: 5%

a specific gravity	*b* % weight	*c* dry basis % ash	*d* clean coal in %	*e* refuse in %
1.35	76.0	4.43	94.18	7.61
1.35–1.45	9.1	15.04	5.51	22.83
1.45–1.55	5.3	26.87	0.24	25.94
1.55–1.65	3.4	26.39	0.07	16.11
1.65–1.80	3.0	45.07	0	14.36
1.80–1.95	1.1	53.21	0	3.09
1.95	0.4	59.43	0	10.06
	1.7	74.46	0	
	100.–		100.–	100.–

Clean coal in % of feed = 77.79%
Ash clean coal: 5.12%
Ash refuse: 32.73%
Specific gravity of separation: 1.39

Table V

Example No. 2
½ in. sq by 35 mesh refuse from dry cleaning plant
Miller B seam—Pennsylvania
required ash: 6 %
ash raw coal: 22.03%

a specific gravity	*b* % weight	*c* dry basis % ash	*d* clean coal in %	*e* refuse in %	*e* example 1
1.35	53.3	5.42	92.92	2.78	7.61
1.35–1.45	8.2	14.83	6.47	10.40	22.83
1.45–1.55	7.2	26.50	0.41	15.4	25.94
1.55–1.65	8.6	35.49	0.16	17.08	16.11
1.65–1.80	8.5	44.43	0.04	22.03	14.36
1.80–1.95	4.5	53.63	0	32.31	3.09
1.95–2.17	2.4	60.60	0		10.06
2.17	7.3	72.92	0		

Clean coal in % of feed = 56.05%
Ash clean coal: 6.06%
Ash refuse: 42.41%
Specific gravity of separation: 1.39

Table VI

Example No. 3
1 in. sq by 35 mesh raw coal including crushed plus 1 in. raw coal
American seam—Alabama
ash raw coal: 26.58%
required ash: 3.5 %

a specific gravity	*b* % weight	*c* dry basis % ash	*d* clean coal in %	*e* refuse in %
1.40	66.8	3.30	98.03	2.69
1.40–1.55	3.1	18.54	1.93	5.52
1.55–1.70	1.8	32.72	0.04	5.40
1.70–1.90	1.8	47.94	0	5.47
1.90	26.5	84.34	0	80.92

Clean coal in % of feed = 67.25%
Ash clean coal: 3.51%
Ash refuse: 73.88%
Specific gravity of separation: 1.45

Table VII

Example No. 4
⅜ in. by 35 mesh raw coal
Pittsburgh No. 8 seam—Pennsylvania
ash raw coal: 16.07%
required ash clean coal: 6 %

a specific gravity	*b* % weight	*c* dry basis % ash	*d* clean coal in %	*e* refuse in %
1.45	83.69	5.77	98.34	2.25
1.45–1.50	1.10	20.53	1.08	1.18
1.50–1.55	0.80	25.80	0.47	3.29
1.55–1.60	0.71	30.33	0.09	4.14
1.60–1.70	0.82	36.41	0.02	5.12
1.70–1.90	1.31	45.01	0	7.76
1.90–2.17	1.48	61.19	0	76.22
2.17	10.09	87.29	0	

Clean coal in % of feed = 84.78%
Ash clean coal: 6%
Ash refuse: 72.16%
Specific gravity of separation: 1.52

Table VIII

Example No. 5
¾ in. by 35 mesh raw coal—Cary seam—eastern Virginia
ash raw coal: 11.67%
required ash clean coal: 6 %

a specific gravity	*b* % weight	*c* dry basis % ash	*d* clean coal in %	*e* refuse in %
1.35	70.3	4.92	87.51	5.67
1.35–1.40	9.3	11.92	9.36	9.04
1.40–1.45	5.9	16.30	2.74	18.79
1.45–1.50	3.2	21.10	0.28	13.70
1.50–1.55	1.7	25.67	0.06	8.80
1.55–1.60	1.3	30.75	0.03	5.61
1.60–1.70	2.2	36.23	0.02	9.89
1.70–1.90	2.3	45.11	0	11.42
1.90	3.8	95.58	0	18.08

Clean coal in % of feed = 78.98%
Ash clean coal: 6%
Ash refuse: 32.95%
Specific gravity of separation: 1.41

Table IX

Example No. 6
¾ in. by 35 mesh—Illinois No. 6 seam—Perry County, Ill.
ash raw coal: 20.55%
required ash clean coal: 6 %

a specific gravity	*b* % weight	*c* dry basis % ash	*d* clean coal in %	*e* refuse in %
1.35	58.36	5.13	92.89	11.45
1.35–1.40	9.97	11.60	6.21	14.69
1.40–1.50	8.31	18.35	0.78	19.01
1.50–1.60	3.01	28.88	0.08	6.97
1.60–1.70	2.32	38.89	0.04	5.38
1.70–1.90	3.65	49.05	0	8.74
1.90	14.38	78.70	0	33.76

Clean coal in % of feed = 57.65%
Ash clean coal: 6.09%
Ash refuse: 40.24%
Specific gravity of separation: 1.36

The efficiency varies from 99.5 percent to 92.2 percent, depending on the type of coal to be washed. It will be clear that the efficiency drops for coal with a high percentage of near-gravity material.

Example No. 6, being coal from Illinois No. 6 seam, Perry County, Ill., is exceptionally difficult to clean. In such a case an efficiency of 92.2 percent is still very good.

These calculated results can be obtained with one separation without any recirculation product, as is mostly done, for instance, in jig washers.

If necessary, results can be improved by rewashing the sink product in a secondary cyclone and by recirculating the floats of this secondary cyclone into the primary cyclone. Generally speaking, this will not be done very often, as the results obtained in the primary cyclone are mostly very satisfactory.

The author wishes to thank Mr. Wender of Roberts & Schaeffer Co. for forwarding him the typical examples of American coal seams and his colleagues of the Dutch State Mines for their cooperation.

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Table X

Ex.	Type of coal	% of near gravity ±0.1 from sp gr of sep.	sp gr of sep.	E_p (probable error)	*a* Yield clean coal in % raw coal	Ash content clean coal	*b* Theor. yield at obtained ash	Diff. in yield	Eff. $\frac{a}{b} \times 100$ in %	Theor. ash at obtained yield	Ash diff.
1	Miller B seam Pennsylvania	25.0	1.39	0.028	77.79	5.12	80.50	2.71	96.6	4.82	0.30
2	Refuse from dry cleaning plant Miller B seam Pennsylvania	22.2	1.39	0.028	56.05	6.06	58.40	2.35	96.0	5.73	0.33
3	American seam Alabama	6.3	1.45	0.029	67.25	3.51	68.20	0.95	98.6	3.36	0.15
4	Pittsburgh No. 8 seam Pennsylvania	4.2	1.52	0.031	84.78	6.00	85.20	0.42	99.5	5.91	0.09
5	Cary seam Eastern Virginia	30.3	1.41	0.028	78.98	6.00	81.30	2.32	97.2	5.76	0.24
6	Illinois No. 6 seam Perry County, Ill.	69.6	1.36	0.027	57.65	6.09	62.50	4.85	92.2	5.72	0.37

Operators' Corner

Spring Servicing of Ignitron Rectifier Cooling Systems

By

CALVIN H. FURFARI

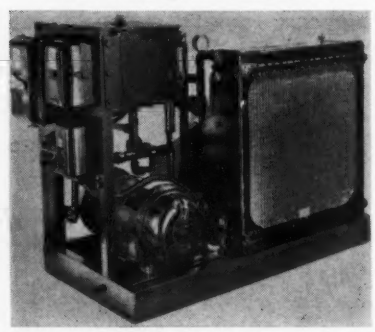
Consulting & Application Engineer
Westinghouse Electric Corp.

BECAUSE the reliability of an ignitron rectifier depends upon the trouble-free operation of its cooling system, this component should receive special attention in every well-planned maintenance program. To help you keep your rectifier down-time at a minimum, the following preventive maintenance procedure is presented as a SPRING SERVICING suggestion.

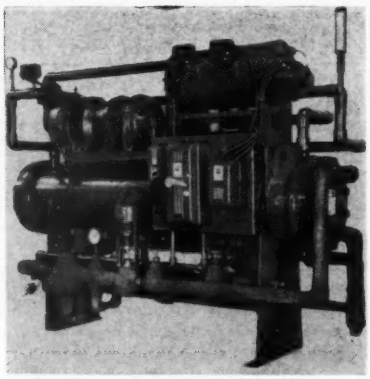
1. **Drain the cooling system and flush with clear water.**
2. **Inspect the cooling system targets, strainer, and piping.**
3. **Replace the targets if they are eroded, clean the strainer, and repair any leaks in the piping.**
4. **Fill the system with clean distilled water and add a corrosion inhibitor consisting of 0.5 percent sodium dichromate and 0.5 percent borax by weight (0.7 ounces of each for each gal of water in the system).**

If the system shows signs of severe corrosion deposits and clogging, the following procedure should be used for flushing:

1. **Drain the system and fill it with tap water to approximately 95 percent of capacity.**
2. **Add any good commercial radiator flushing compound, provided it contains an oxalic acid base. (When using a commercial flush it is very important that the directions contained on the can are followed carefully.)**
3. **Circulate the compound for the required time as set forth in the directions on the container.**



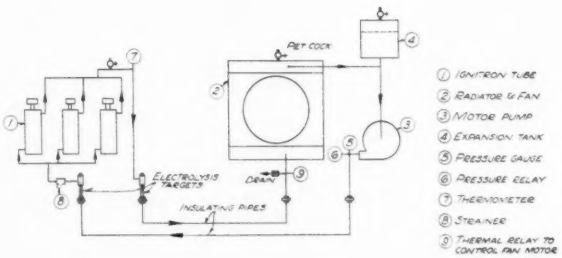
Water-to-air heat exchanger for portable and stationary ignitron rectifier



Stationary rectifier water-to-water heat exchanger showing the location of the temperature regulator, pressure and temperature indicators, and the end flanges to be removed for cleaning the raw-water tubes

9. **After the short time interval, the tubes should be drained and reconnected to the water system and the entire system filled with distilled water.**
10. **The water should be circulated for about 15 minutes and drained. The system should then be filled with clean distilled water and corrosion inhibitor as detailed above.**

For units having water-to-water heat exchangers, the raw-water system should be inspected and receive separate servicing.



Ignitron cooling system

4. **Drain the system and refill it with tap water. Circulate the tap water for 15 minutes and then drain the system.**
5. **For pumped tubes, refill the system with distilled water and add a corrosion inhibitor as detailed above.**
6. **For sealed tubes, the following additional procedure is necessary. Remove the tubes and plug the bottom water-connector nipple.**
7. **Fill each tube with 20 percent warm nitric acid solution through the top water-connector nipple. The nitric acid is intended to act as a passivating agent for the stainless steel water jacket.**
8. **When the tube is full, the solution should immediately be poured out and replaced by a 50 percent solution of ammonium hydroxide (28 percent ammonia in water). The ammonium hydroxide solution should be left in the water jacket for a minute or two.**

1. **Inspect the raw-water strainer and clean or replace it as necessary.**
2. **Operate the temperature-regulating valve with the lifting-fork provided in order to prevent sticking due to prolonged periods of constant load operation.**
3. **If the system shows signs of corrosion deposits, remove the end flanges of the heat exchanger and clean the individual tubes by passing a wire brush through them.**
4. **After the tubes are clean, replace the flange gaskets and flanges, and refill the exchanger with raw water.**

The preceeding program should insure efficient cooling system operation for many months. However, the procedure should be repeated as often as proves necessary by the specific operating conditions.

As Viewed by HARRY L. MOFFETT of the American Mining Congress

CONGRESSIONAL legislative action, traditionally slow during the first few months of a new Congress, is picking up steam and the leadership is making a drive for an early summer adjournment.

Many members are itching to get back to the "grass roots" to start campaigning for 1960 elections. Recognizing this, the leadership in the House is seeking to have the Appropriations Committee send the last of the money measures to the House floor by June 6. There appears a fairly good chance that this goal may be attained although the foreign aid funds bill may retard the schedule.

No mining program has been set forth by the Administration, which apparently intends to see what Congress proposes before taking any action. Meanwhile, both the House and Senate Interior Committee have numerous measures pending which propose policies to aid domestic mining. The House Interior Committee plans broad hearings into the state of the industry probably this month.

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Washington Highlights

LABOR BILL: Fate uncertain.
COAL RESEARCH: Independent commission voted.
DPA INVENTORY: Bill would restrict sales.
STOCKPILING: Funds cut sharply.
LEAD-ZINC PROBLEMS: Aired at United Nations.
MINING AID: Sought by House members.
TVA: Bond bill approved by House.
PREMERGER-PRICE BILLS: In Senate Committee.
STATES' RIGHTS: Smith measure advances.
UNEMPLOYMENT COMPENSATION: Federal standards denied.

★ ★ ★ ★ ★ ★

LABOR BILL'S FATE UNCERTAIN

Although the Senate overwhelmingly passed a somewhat strengthened Kennedy labor reform bill late in April, what action the House may take on this or any other union reform legislation remains clouded. A House Labor subcommittee has been holding hearings on all pending labor bills since March 4, and indications are that debate on whatever bill is approved by the full committee will begin some time next month.

Presaging an all-out House floor battle is last month's about-face by the AFL-CIO, which had supported the original Kennedy bill as approved by the Senate Labor Committee. After examining the amended measure passed by the Senate, the union's executive council announced that it opposes the bill "in its present form" on the ground that it would "jeopardize the liberty of all trade unionists."

Other major unions, such as the United Mine Workers, have consistently opposed reform legislation as unnecessary, and the House Labor Committee, heavily weighted with "liberals," is likely to report an ineffectual bill to the House.

Meanwhile, Republicans and conservative Democrats on the Committee have sponsored bills which they believe would be more effective in dealing with union abuses than the Kennedy measure. Leaders of these groups are Rep. Kearns (Rep., Pa.), ranking Republican on the Committee, and Chairman Barden (Dem., N. C.).

They are striving for the same objective—a bill that will prove appealing enough to weld a voting union comprising most of the House's 151 Republicans and 80-odd Southern Democrats. Such a coalition could resist any effort of organized labor to defeat the legislation. Whether their efforts will be successful remains to be seen.

COAL RESEARCH PROPOSAL ADVANCES

Legislation to establish a Coal Research and Development Commission as an independent agency of the Federal Government has been approved by the House Interior Committee.

The measure calls for a three-member Commission, charged with developing a research program to find new and more effective uses of coal, improve and expand existing uses, reduce the cost of production and distribution, and emphasize those developments in uses for coal of particular value to small coal producers.

The Commission must endeavor to have research projects conducted by some qualified private organization before undertaking such projects on its own, and none of the Commissioners may be employed by or have any interest in any coal mining firm.

DPA INVENTORY DISPOSAL

A bill to bar Government sales of metals or minerals acquired under the provisions of the Defense Production Act has been introduced by Chairman Aspinall (Dem., Colo.) of the House Interior Committee. The bill would require approval of such sales by both the House and Senate Interior Committees, thus placing a measure of restriction on disposal of DPA inventories, which are not sub-

ject to the restrictions of the stockpile act.

The bill is an outgrowth of previous disclosures that the Government was studying plans to dispose of copper in the DPA inventory, and it is anticipated that a similar Senate bill will be forthcoming. The Senate had rushed through a resolution opposing sales of Government copper, and as a result the Government said it had no plans to dispose of any copper.

Meanwhile, there are indications that members of the Senate may attempt to amend a pending appropriations bill to bar disposal of such inventories without Congressional approval.

STOCKPILING FUNDS SLASHED

A $6.4 billion appropriation measure carrying funds for a number of independent Federal agencies, including stockpiling funds handled by the General Services Administration, has been passed by the House and sent to the Senate.

Earlier, the House Appropriations Committee had made drastic reductions in funds for stockpiling strategic and critical materials. It rescinded approximately $107 million in unobligated funds for stockpile purchases, and refused to provide some $49.4 million for purchase of new rotated materials. Net result of the House action was to allow the agency to keep $33 million for operating the stockpile program during the next fiscal year; this amount includes only $6.5 million for purchase of new materials and $2.6 million for upgrading of materials.

U. N. GROUP WORKS ON LEAD-ZINC PROBLEMS

The Lead-Zinc Committee of the United Nations, representing some 20 producing nations, concluded a meeting in New York early in May at which proposals were made for further reductions in production and exports of lead and zinc in order to improve supply-demand relationships.

The Committee also called for better statistical data on production and consumption of lead and zinc, and for the creation of an international Lead and Zinc Study Group.

With regard to cuts in production, the U. N. Committee announced that voluntary agreements from 11 member nations would reduce output or exports (in metric tons) by 45,500 tons for lead and 52,000 tons for zinc in the second half of this year. The Committee estimated that, with a steady rate of consumption, the 1958 excess of available world supply of lead would be decreased to an annual rate of 59,000 tons instead of 150,000 tons, and that of zinc to 16,000 tons instead of 120,000 tons.

All participating governments have been asked to indicate whether they will become members of the Lead and Zinc Study Group. The date and place of the first meeting of the group will be set by the U. N. Secretary-General after he is satisfied that a sufficient number of major exporting and importing countries plan to join.

RESOLUTION ASKS MINING INDUSTRY AID

Chairman Aspinall (Dem., Colo.) and seven other members of the House Interior Committee have introduced resolutions requesting the President to review and revise existing programs of Federal Departments and agencies, with a view to their more effective use in increasing production and employment in critically depressed mining and mineral industries. Other sponsors are Reps. Rogers (Dem., Texas), Pfost (Dem., Idaho), Powell (Dem., N. Y.), Edmondson (Dem., Okla.), Baring (Dem., Nev.), Ullman (Dem., Ore.), and Saylor (Rep., Pa.).

A resolution of this type has no legislative force on the Executive Department; it merely sets forth the views of Congress. It does, however, give the House Interior Committee, to which the resolutions were referred, an opportunity to hold hearings on the current problems of various segments of the mining industry. The committee tentatively planned to begin its hearings in June.

HOUSE APPROVES TVA BOND BILL

The House has approved and sent to the Senate a bill which would authorize the Tennessee Valley Authority to issue bonds to finance new power facilities.

The measure was the subject of heated debate in the House, and Republican attempts to add amendments which would effect some sort of Governmental control of the bond issues failed.

As approved by the House, the measure authorizes TVA to issue bonds in the amount of $750 million to finance future expansion, and permits the agency to fix the terms and conditions of the bonds after "consultation" with the Treasury Department. It requires TVA to charge rates sufficient to operate the power system, service the bonds, and meet obligations specified in the bill with respect to the repayment of the Government's investment in the system.

The proposed bill prohibits TVA, with a few minor exceptions, from expanding its marketing area beyond present limits, this latter provision being one of several sought by the coal industry.

A Presidential veto has been hinted unless the Senate is able to amend the bill to effect fiscal control of the bond issues by the Federal Government.

PREMERGER PRICE BILLS STILL IN COMMITTEE

Awaiting action in the full Senate Judiciary Committee is a bill approved by its Antitrust Subcommittee which would require that the Government be given 60 days' advance notice of planned mergers, if the combined capital of the merging concerns exceeds $10 million and stock transferred is worth over $2 million.

Of concern to the mining industry is that the Subcommittee-approved version would remove the original bill's exemption for mergers where 75 percent or more of the assets consist of *undeveloped* mineral, mining or timberland properties. The Subcommittee retained the exemption on mergers where 75 percent of the assets consist of *partially developed* properties of that nature.

The American Mining Congress has urged the full Judiciary Committee to restore the original exemption language.

The AMC and other industry organizations had also asked the Subcommittee to add an additional sentence to the mineral properties exemption, which was done. That sentence provided that "In the case of coal and petroleum, partially developed mineral or mining properties are properties from which the total quantity of the minerals produced or removed prior to date of acquisition does not exceed the remaining minerals in the properties acquired."

Also pending before the Senate Judiciary Committee is the so-called "price discrimination" bill, which would restrict the "good faith" defense in charges of price discrimination.

This controversial legislation, which has been before Congress for many years, would reverse the established right of a seller to lower his price to one customer to meet the equally low price of another seller without being forced to lower his price to all customers.

The American Mining Congress appeared in opposition to the meas-

ure at the hearings last March, and in support of another bill which would establish that the good-faith meeting of a competitive lower price is a complete defense to a price discrimination charge.

STATES' RIGHTS BILL MOVES

A bill dealing with joint Federal-State occupancy of fields of law, the so-called States' rights bill, has been approved by the full House Judiciary Committee. It is anticipated that the measure will be given early clearance by the House Rules Committee, inasmuch as its author, Rep. Smith (Dem., Va.), is Chairman of the latter Committee.

It is designed to prevent the Supreme Court from overturning State laws which are not in conflict with Federal laws on the same subject.

UNEMPLOYMENT COMPENSATION BILL APPROVED

The House Ways and Means Committee has approved a bill which would amend existing unemployment compensation insurance laws.

The measure was a disappointment to organized labor in that it did not provide Federal benefit standards.

As approved by the Committee, the bill would extend unemployment insurance only to persons employed by business-type enterprises operated by non-profit institutions, and to the overseas employees of United States airlines. The Administration had asked that coverage be greatly extended and that it include employers of one or more employees, but the new proposal leaves the present rule of four or more employees intact.

The Committee also rejected an Administration suggestion that the taxable wage base under the law be extended from $3000 to $4200, providing instead an increase in the tax rate from 3 percent to 3.1 percent. The Federal Government's share would be increased from .3 percent to .4 percent, with the so-called "standard rate" with respect to State laws remaining at 2.7 percent.

CONTINUOUS METHANE MONITORING SYSTEM AT WORKING FACE

(Continued from page 47)

quired to check for gas at specified times, but the periods between checks can hold the key to disaster, and the human element of error or carelessness may still be present.

The methane-monitoring system will greatly relieve the men from the responsibility of checking for gas and yet do a more complete job. Reliability can be built into such a system, too. The telephone is used every day and seldom fails to function properly. Yet telephones are possible only by using many relays, electronic devices and other equipment. It is generally accepted today that well-designed machines and devices with good reliability built in are more dependable than human operation.

Just as airplane travel has become reliable enough so that most persons never hesitate to use air travel, so is it possible that we can see the day when our methane detection will be done automatically and reliably, so that a great advance in mining safety will have been accomplished.

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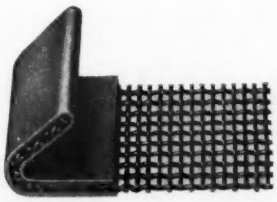
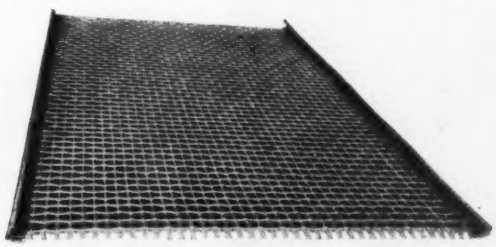
Tyler Woven Wire Screens are woven with laboratory approved wires on precision machines. The high quality of Tyler Screens is apparent in their long life and service under the most difficult of screening conditions.

Tyler Screen Sections are furnished for all makes of vibrating screens in all meshes and metals. Each section is fabricated with the right type of edge or hook strip for the specification of screen cloth and to fit the particular make and model of screening machine on which it will be used.



Tyler Type "AX" Hook Strip. For wire diameters from .047" to 5/16" inclusive.



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personals

Lawrence L. Litchfield, Jr., has been made an executive vice president of Aluminum Company of America. Litchfield, an alumnus of the U. S. Naval Academy and Harvard University, joined Alcoa as a geologist in 1925. He was elected president of Alcoa Mining Co., a former Alcoa subsidiary, in 1952. A year later, the mining firm became a division of Alcoa; and Litchfield was named general manager. In 1956 he was elected vice president in charge of the division, and last year his executive responsibilities were broadened to include both the raw materials and refining divisions.

H. C. Livingston has been named chief executive officer of Truax-Traer Coal Co. He is also president. **Garner Williams** resigned from the board of the company after serving as a director for almost 30 years.

Evan Just has been named professor and head of Stanford University's Department of Mineral Engineering. Just will leave his post as president of International Drilling & Water Co., Inc. to take over his new teaching duties next fall. Previously a vice president of Cyprus Mines Corp. and editor of *Engineering & Mining Journal,* Just will use his wide experience in the mining and petroleum industries in the future development of Stanford's mineral engineering department.

Louis Fyock was installed as president of the Mid-State Coal Mining Institute at the annual membership banquet held at Camp Ceaser near Summersville, W. Va.

Thomas E. Long has been appointed eastern regional manager of Portland Cement Association. In his new position, Long will supervise the Association's field activities in eleven eastern states from the regional office in New York City. He succeeds **Miley J. McMillan,** who has been named to the new position of senior consultant in the promotion division. McMillan will remain in New York during the initial phase of his new assignment.

West Virginia University has conferred an honorary degree of Doctor of Laws on **Walter J. Tuohy,** president of the Chesapeake & Ohio Railway.

The appointment of **E. W. Coffey** as vice president, traffic, Peabody Coal Co., has been announced. In addition to the duties of this office, Coffey will continue to serve as vice president and general manager of Peabody's St. Louis Coal Sales Co.

John J. Collins, formerly with American Smelting & Refining Co., has been named general manager of Revere Copper & Brass' new mining department. The department will develop bauxite ore sources, and will be located in Revere's executive offices in New York.

Clark D. Todd has been appointed management engineer for Princess Coals, Inc. He will maintain offices in Huntington, W. Va., and report directly to the president of the company.

William H. Hays has been named State inspector of mines for New Mexico by Governor John Burroughs. He has been granted a leave of absence from the Potash Division, International Minerals & Chemical Corp., to accept the appointment.

G. W. DeLaMare, general superintendent of United Park City Mines Co. of Park City, Utah, has accepted a partnership in the Iron King iron ore mine near Winnemucca, Nev. **Walter J. DeZell,** manager of mining at the Conda, Idaho, phosphate property of Anaconda Co. has succeeded DeLaMare as superintendent.

Ben R. Walburn has been promoted to chief mining engineer of Republic Steel Corp., succeeding **Joseph R. McVicker** who has moved up to general manager of the corporation's coal mines. Walburn joined Republic last October as assistant chief mining engineer. Before that he was associated with Jones & Laughlin Steel Corp.

B. R. Walburn

M. D. Hassialis, head of Columbia University School of Mines, was elected president of Pacific Uranium Mines Co. Pacific Uranium, with Kerr-McGee Oil Industries, Inc. and Anderson Development Corp., owns an interest in Kermac Nuclear Fuels Corp., which operates a 3300-tpd uranium mill near Grants, N. M. The company also owns some property which supplies ore to the mill.

William H. King, who was Bureau of Mines supervising engineer at Denver at the time of his recent death, has been honored posthumously with the Department of the Interior's Meritorious Service Award and Silver Medal. The award was presented to his widow, Mrs. Pauline King of Denver. The accompanying citation states that it was made "in recognition of his numerous achievements and superior service in both engineering and administration."

United States Steel Corp. has announced the appointment of **E. H. Gott** as administrative vice president—central operations (steel and coal). Gott succeeds **Stephen M. Jenks,** who has been appointed executive vice president—engineering and research.

Sherman Westgard, superintendent of copper refineries of the Great Falls, Mont., reduction department of the Anaconda Co., has been appointed superintendent of copper refineries, Raritan Copper Works, International Smelting & Refining Co., Perth Amboy, N. J. International is a wholly-owned Anaconda subsidiary. Westgard is a 1938 chemical engineering graduate of Montana State College.

The Chesapeake & Ohio Railway Co. has announced the appointment of **Tom J. Hayes** as special representative in the Coal Development Department with headquarters in Huntington, W. Va.

Erskine A. Massey, since 1954 assistant superintendent of International Minerals & Chemical Corporation's phosphate mines at Bartow, Fla., has been transferred to that company's Mining and Exploration Department as a mining engineer, with headquarters in Skokie, Ill. Massey came to IMC from Tennessee Coal and Iron Division of U. S. Steel Corp. as a mine foreman in 1953. He is a mining engineering graduate of the University of Alabama.

Don E. Manuel, first and only commodore of U. S. Steel Corporation's Pittsburgh Steamship fleet, retired recently after 45 years of sailing the Great Lakes.

Pacific Coast Borax Co., a division of U. S. Borax & Chemical Corp., has announced the appointment of **Robert T. Edgar** as division vice president in charge of production. He will have over-all supervision of the Borax Co. plants at Boron and Wilmington, Calif.

Thomas Archibald Stone, Canadian Ambassador to the Netherlands from 1952 until the end of last year, has been named special assistant to the president of the International Nickel Co. of Canada, Ltd. He will also serve as special assistant to the company's United States subsidiary, The International Nickel Co., Inc.

J. K. Thorney has been appointed general coal freight agent of the Baltimore & Ohio Railroad, with headquarters at Baltimore. He succeeds **S. I. Thompson,** recently retired.

Colorado Fuel and Iron Corp. has named **Samuel A. Ott** vice president in charge of eastern division operations. His headquarters will be in New York.

Lyman H. Hart, chief geologist, American Smelting & Refining Co., for the last 13 years, has been named consulting engineer for Guggenheim Brothers. He will be in charge of exploration for the firm, which is planning to enter aggressively into new projects in the fields of metals in the United States, Canada, and especially in Latin America.

William H. Love has been promoted to general manager of the Hecla Mining Co. He joined Hecla in 1948 as mechanical engineer and in 1951 was named superintendent of exploration at Hecla's Atlas project near Mullan, Idaho. In 1954 he went to Moab, Utah, as superintendent of the company's radon uranium mine and in 1956 became manager of mines for Hecla.

Ross D. Leisk and **Henry L. Day,** have been elected members of the board of directors of Pend Oreille Mines & Metals Co. succeeding **L. J. Randall** and **Stanley W. McDougall.**

Dr. Earl T. Hayes has been named chief metallurgist for the U. S. Bureau of Mines with headquarters at Washington, D. C.

Myron L. Sisson, superintendent of Colorado Fuel & Iron Company's Sunrise mine has been elected president of the Wyoming Mining Association, succeeding **Glenn E. Sorensen,** president of Kemmerer Coal Co.

Kennecott Copper Corp. has announced the election of **William F. Macklaier** to the board of directors, filling a vacancy created by the retirement of **Arthur W. Page,** who has been a director of Kennecott since 1943. Macklaier is a partner of the law firm of Hugessen, Macklaier, Chisholm, Smith & Davis of Montreal, Canada.

At the recent annual meeting of shareholders of the Eagle-Picher Co., **Albert S. Ault,** president of the Chicago Vitreous Corporation Division, was elected a vice president of the company.

J. A. Boyle, has succeeded **G. H. Sambrook** as director, mine inspection, United States Steel Corp. Sambrook is retiring.

Allen D. Gray has been named president of Fremont Minerals, Inc., and Mines Development Inc., subsidiaries of Susquehanna Corp. Fremont Minerals, Inc. owns and operates a uranium mill and a sulphuric acid plant at Riverton, Wyo. Mines Development operates a uranium mill at Edgemont, S. D.

Wayne Meadows is the new mechanical superintendent of Snyder Mining Co. He succeeds **A. A. Erickson** who retired.

James D. Moore, former production manager, has been named plant manager at Vitro Uranium Company's 660 tpd uranium mill in Salt Lake City.

Zeigler Coal & Coke Co. has added one member to its board of directors, increasing the number to ten. **Roland Wilson,** vice president in charge of production, Bell & Zoller Coal Co., a wholly owned subsidiary of Zeigler Coal & Coke, is the newly elected member.

Carter P. Thatcher has been appointed vice president, mining operations, for Yuba Consolidated Industries, Inc. He will concentrate on expanding Yuba's mining activities.

Several changes have been announced in the executive sales staff of the Sahara Coal Co., Inc. **E. W. Boreckle** is retiring as sales manager, as is **Frank Muller,** assistant manager.

M. B. Nugent, assistant sales manager for the past four years, has been named sales manager, and **Henry Eggert** has been promoted to assistant sales manager. **Stewart Byrne** was also appointed assistant sales manager.

OBITUARIES

Henning J. K. Marstrander, 66, a mine inspector, was accidentally killed near Helena, Ala., March 31. Mr. Marstrander had been an inspector for the U. S. B. M. in the Birmingham district for the last 14 years.

Emory C. (Mark) Hanna, vice president of Carbon Fuel Co. died March 18 in a Charleston, W. Va., hospital where he had been under treatment for several weeks. Mr. Hanna was one of the State's best known coal men. He joined Carbon Fuel at Carbon, W. Va., as a bookkeeper in 1905, transferring to Charleston in 1929. He was successively auditor, treasurer and assistant to the president of the company.

Howard C. Paulsen, 54, a director of Day Mines, Inc., and member of one of the Coeur d'Alene district's earliest families, died March 3 in Honolulu. He suffered a heart attack about a week prior to his death, shortly after his arrival for a vacation in the Hawiian Islands. Mr. Paulsen was a director of the Washington Water Power Co. and was also affiliated with several other Spokane corporations.

NEWS and views

Hanna Opens New Plant in Michigan

M. A. Hanna Company's multi-million dollar beneficiation plant near Randville, Mich., has started commercial production. The first shipment of powdered iron concentrate was recently shipped by rail to Granite City Steel Co., Granite City, Ill. The plant will gradually increase production and is expected to be in full operation by September. At that time the daily concentrate production will be 2000 tons.

The project consists of five buildings—primary crusher, secondary crusher, main concentration plant, main office and service building, and garage and warehouse. The area which Hanna will mine covers more than 3000 acres and will be an open pit operation. The area will be mined in places to a depth of 500 ft, depending on the extent of the ore bodies.

Morrow Receives Annual BCR Award

The 1959 Annual Meeting of Members and Techno-Sales Conference of Bituminous Coal Research, Inc., the national research association for bituminous coal, was held April 21–22 at the Sheraton Hotel in Chicago, Ill. This year's meeting was devoted to the application by industry of new coal-using equipment and processes resulting from cooperative coal industry-sponsored research and the Techno-Sales Conference was based on the marketing of coal-burning and coal-handling equipment.

J. D. A. Morrow, director and consultant for Joy Manufacturing Co., was presented the seventh Annual BCR Award at the annual banquet. This citation honors representatives of BRC member companies who have exerted outstanding leadership contributing to the progress of industry-sponsored coal research, and can be earned by exemplary achievement in promoting research support, utilizing BCR research results to expand markets, or otherwise contributing to the progress of the bituminous coal industry through a BCR activity.

Caland Project on Schedule

Inland Steel Company's wholly-owned Canadian subsidiary, Caland Ore Co., Ltd., moved steadily closer to production during the past year. The round-the-clock dredging operation at Falls Bay area of Steep Rock Lake near Atikokan, Ontario, has resulted in the removal of 129,000,000 cu yd of silt. Approximately 40,000,000 cu yd of silt remain to be dredged before this phase of the program is completed.

Development work on the open pit and underground mines is well underway and the first shipment of ore scheduled for 1960, according to Inland Steel's Annual Report for 1958.

Consolidation Top Producer in 1958

Production of the top 15 producers in the coal industry in 1958 totaled 151,699,687 tons, against 186,401,077 for the top 15 in 1957, according to a special supplement of the Keystone Coal Buyers Manual. Collectively, the 15 leaders in 1958 showed a loss of 15.9 percent, compared to a loss of 18.3 percent for the bituminous industry as a whole. All together, the leading 15 produced 37.9 percent of the 1958 estimated bituminous tonnage.

Consolidation Coal Co. held its place as the industry's leading producer, producing 6.9 percent of the total bituminous tonnage. The Peabody group was second and U. S. Steel Corp. third.

The top 50 operating groups, bituminous and lignite, increased their share of the total from 58.9 percent in 1957 to 60.2 percent in 1958. Percentage of production of the top 50 groups has increased each year since 1947.

Sulphur Company To Explore Asbestos Property

Jefferson Lake Sulphur Co. of New Orleans, La., and American Asbestos Mining Corp. of New York and San Francisco have signed an agreement whereby Jefferson Lake has been granted the right to explore and develop the asbestos mining property situated in Calaveras County, Calif., owned by American Asbestos. American Asbestos is controlled by Robin International, Inc. of New York.

Reports by geologists and mining engineers have been favorable and indicate a deposit of asbestos fibre of the chrysotile variety.

Sentinels of Safety Trophy Awarded

Winners of the National Safety Competition conducted by U. S. Bureau of Mines have been notified that they will receive the bronze Sentinels of Safety Trophy awarded each year by *Explosives Engineer* magazine to the first place winners in each classification. Six hundred seventy-five mines and quarries were entered in the competition in 1958, a new high in entrants in the history of the competition.

Winners for 1958 are: anthracite underground mine — Germantown Colliery, Raven Run Co., Centralia, Pa.; bituminous coal underground mine—No. 14 Mine, U. S. Steel Corp., Gary, W. Va.; metal underground mine—Pioneer Mine, Oliver Iron Mining Co., Ely, Minn.; nonmetallic underground mine—Grand Rapids Mine, Bestwall Gypsum Co., Grand Rapids, Mich.; open pit mine—Erie Commercial Mine, Pickands Mather & Co., Hoyt Lakes, Minn.; quarry—Thornton Quarry, Material Service Corp., Thornton, Ill.

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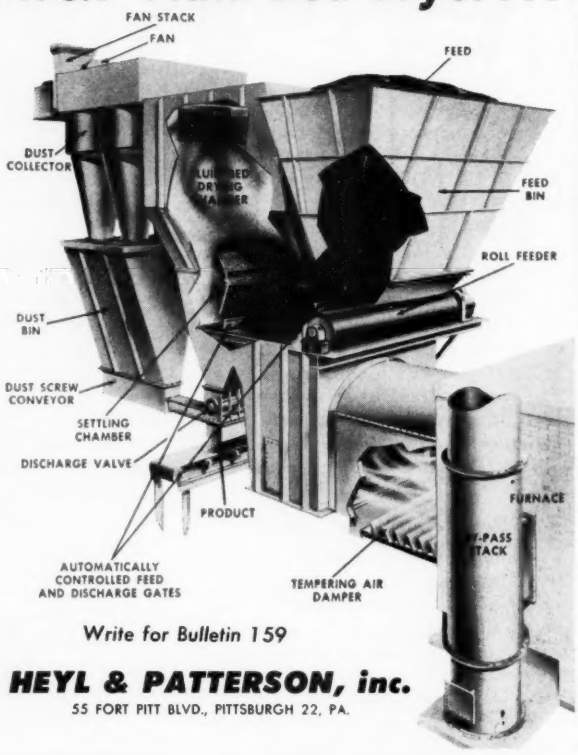

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Pipelines for Solids Seen Feasible for Industrial Uses

New engineering concepts in transportation of solids through pipelines can now open the way to a whole new area of cost reduction in many industrial operations, according to Julian Nardi, chief mechanical engineer of Ford, Bacon & Davis, Inc., engineers and management consultants.

Speaking before the joint session of the pipeline and power divisions of the American Society of Civil Engineers in Cleveland, recently, Nardi cited "the partial processing of solids while in transit in a pipeline" as a possible key to "a whole new line of products that could be economically pumped through a pipeline."

Nardi, pointed out that "pipeline transportation has two basic advantages over railroads and trucks—a smaller proportion of its operating costs are in labor and materials, both of which are apparently in an upward price spiral, and the cost of returning empty is eliminated."

"A pipeline is more economical than railroads and trucks, only when large quantities, many years of useful life, high annual loads and relatively long distances are involved, or when some special circumstances exist. The cost of preparing the slurry and dewatering it at the terminal often exceeds the cost of transportation," he continued.

In the last several years, he said, "Ford, Bacon & Davis has made studies of pipelines for transporting rock salt crystals in a saturated brine solution, and limestone, sand, ore, lignite and coal as slurries—for distances from 30 miles up to over 600 miles. Some of these were in foreign countries.

"While each of these proposed pipelines had different and difficult engineering problems, there was always less doubt about the technical feasibility than the economic," he said.

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Mining Congress Journal offers excellent opportunity for mining engineer with experience in nonferrous metal mining. Position involves writing and working with members in the mining industry.
Address inquiries to the editor. Include information on age, education, experience, marital status and a recent photograph.

7000 tpd Coal Mine to be Developed in Illinois

Henry Crown, chairman of Material Service Corp., of which Freeman Coal Mining Corp. is a division, has announced that development will begin promptly of a 7000 tpd, deep shaft, highly mechanized coal mine near Benton, Ill. Initial production from the mine, which will employ some 350 men, is expected in 1960.

To be known as Orient No. 5, this mine will be served jointly by the CB&Q, C&EI, IC and MoP railroads. Cleaning processes in the preparation plant will employ heavy medium separation and air flotation equipment.

Conveyor Belt for Cleveland Proposed

A proposal to construct a multimillion dollar conveyor belt system in Cleveland to carry iron ore from lakefront docks to three inland steel mills is again under study. The Pennsylvania Railroad Co. has proposed use of its lakefront and ore unloading facilities at Whiskey Island and its right-of-way through the industrial river valley for construction of the conveyor belt system. The proposed system would speed up turn-around time for the huge lake freighters delivering iron ore and limestone to Cleveland by eliminating a trip up and down the heavily congested Cuyahoga River.

Soviet Coal Output Believed to Have Exceeded that of U. S.

Rapid expansion of the Soviet coal industry is described in a Bureau of Mines publication recently released by the Department of the Interior. On the basis of information covering Russia's coal production for the first six months of 1958, Bureau experts believe Soviet coal output for the entire year exceeded this Nation's, tonnage-wise, but not in terms of energy. This is because much of Russia's production is lignite, which has a lower heating value than America's bituminous coal or anthracite.

George Markon and George D. Drechsler of the Bureau's Section of Foreign Solid Fuels, Washington, D. C., wrote the publication. It discusses many phases of the Soviet coal industry and includes a map and brief description of principal coal-bearing areas in the U.S.S.R.

A copy of Information Circular 7876, *Some Aspects of the Coal Industry of the U.S.S.R.*, can be obtained by writing the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.

Lectures Given on Exploitation of Foreign Mineral Deposits

Charles F. Park, Jr., dean of the School of Mineral Sciences, Stanford University, recently gave a series of Warren lectures at the University of Minnesota on "Sources of Energy," "Minerals in World Affairs," and "Iron and Steel." These lectures, which were given on April 29 and 30 and May 1, were sponsored by the School of Mines and Metallurgy and the Departments of Geology, Geography, and Concerts and Lectures. They emphasized the political, social and economic problems associated with the exploitation of mineral deposits in foreign and often undeveloped countries.

Hanna Affiliate Enters Wabush Lake Area

The Hanna Mining Co. has revealed that its affiliate, Iron Ore Company of Canada, is starting a huge iron ore project in the Wabush Lake area of Labrador, near Carol Lake.

(*Continued on next page*)

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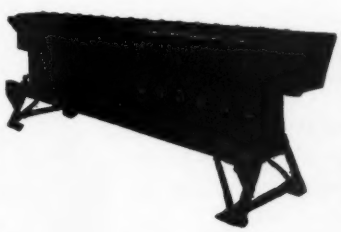

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(Continued from previous page)

It is estimated that this development will cost nearly $200,000,000 and will be completed in 1962. The project will include a plant to produce 6,000,000 tons of high grade concentrates annually, a town to house 3500 persons, a power plant and related facilities.

Pickands Mather & Co. and affiliated firms, through Wabush Iron Co., Ltd., is also developing iron ore in this area on land leased from Canadian Javelin, Ltd., in a $250,000,000 program.

ALSO . . .

The 49th Annual Convention of the Mine Inspectors Institute of America will be held in Terre Haute, Ind., June 22, 23, 24, 1959. The Terre Haute House will be convention headquarters. An interesting and informative program on subjects pertinent to problems encountered in present day mining has been arranged.

American Iron Ore Association has moved to new quarters at 600 Bulkley Building, 1501 Euclid Ave., Cleveland, Ohio.

SALVATI IS WEST VIRGINIA'S SON OF THE YEAR

The West Virginia Society of the District of Columbia recently named Raymond E. Salvati, president of Island Creek Coal Co., Huntington, W. Va., as "Son of the Year." A graduate of West Virginia University, he rose from a trackman to president of one of the Nation's largest producers of bituminous coal in a relatively short span of years. He has received a number of outstanding coal and associated industry awards and is president of the American Mining Congress.

John L. Lewis, president of the United Mine Workers of America, was named "Adopted Son of the Year."

Buckeye Coal Co., a subsidiary of Youngstown Sheet & Tube Co., has acquired almost 18,000 acres of coal property in Green County, Pa., from the J. H. Hillman interests and the Youghiogheny & Ohio Coal Co. Buckeye has no plans for immediate development of these coal deposits, which were purchased to make secure the company's raw materials sources on a long range basis.

Air Pollution Control Association will hold its next annual meeting June 22–26, 1959, at the Hotel Statler in Los Angeles, Calif. This meeting will include technical sessions and exhibits.

Lehigh Valley Industries Inc. recently announced it is withdrawing from the coal producing business and will lease its active mining properties to Pagnotti Coal Co., of Pittston, Pa.

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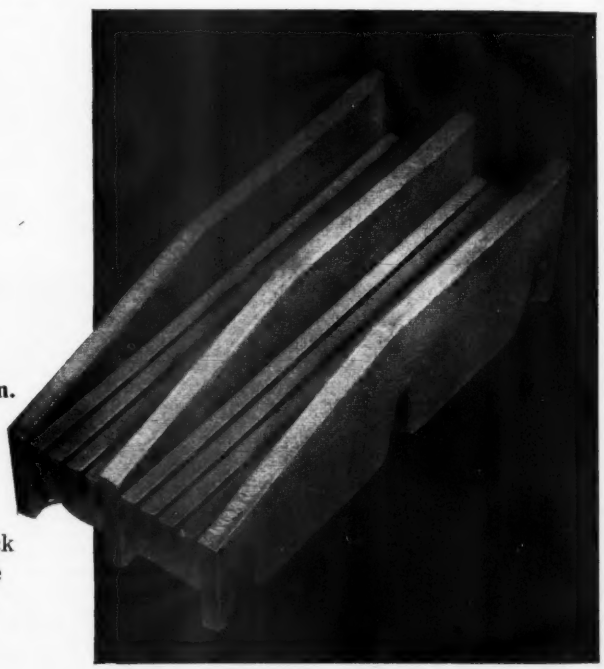

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Allied Chemical Corp. has broken ground at Edgewater, N. J., for a new calcining plant and bulk ship unloading facilities with a capacity of 900 tph. The plant reportedly will be capable of handling 20,000 tons of gypsum in a single shipment.

Curtiss-Wright Corp. has unveiled a new blacktop road-paving material manufactured partly from bituminous coal which reportedly will have longer life and require less maintenance than present asphalt surfaces. In addition to paving roads, the black top compound can also be used for roofing, shingles, floor tiles, tar paper, airport runways, waterproof paper, drain pipes, conduits, auto undercoating and other products. The company developed the new process at its 52,000-acre Quehanna plant. Roy T. Hurley, chairman and president, has proposed a development program which would be conducted by the State and Curtiss-Wright, including paving of 12 half-mile sections of highway with the material.

American Smelting & Refining Co. has put into volume production what it believes is the largest smelter ever built specifically for converting scrap aluminum into alloy ingot. The plant, at Alton, Ill., has a production capacity of 72,000,000 lb of ingot a year. The new smelter almost doubles the company's capacity to produce aluminum alloys.

The development of Inland Steel Company's Armour No. 2 mine at Crosby, Minn., is continuing on schedule. By mid-1959, all mining operations will have been transferred from the adjacent Armour No. 1 mine, which will be exhausted on the expiration of its 50-year lease.

A 42 cu yd coal stripping shovel will be delivered in September to Green Coal Co., Owensboro, Ky. Weighing about 3,000,000 lb, it will dig more than 60 tons in a single bite. Sale of the shovel was recently announced by Bucyrus-Erie Co.

J. J. Forbes Council of the Holmes Safety Association recently presented its annual safety award to Edwards Ore Mine of Republic Steel Corp. for working the entire year 1958 without a lost-time accident.

Discovery of one of the Western World's large deposits of high quality cesium ore was recently claimed by T. C. Mining Co. of West Paris, Me. The discovery was made in Oxford County, where the company produces mica.

The Louisville & Nashville Railroad is planning to cut the rates on coal shipments from southeastern Kentucky to Tampa, Fla. Planned to meet rate competition from water transportation, the reduction would apply only to steam coal, and would apply first to shipments from Corbin, London and Manchester, Ky., to the Tampa Electric Co. steam plant at Tampa.

Sixty thousand square miles of northwestern Ontario are to undergo this summer one of the largest aerial mineral searches ever launched in Canada. James A. Maloney, Ontario Mines Minister, said the aerial part of the survey is to get under way within a few weeks. After its completion, a ground geophysical survey will follow. Total cost of the work will be $700,000. Ontario is to pay two-thirds of the cost of the aerial work, with the balance and the cost of the ground survey to be paid by the federal government.

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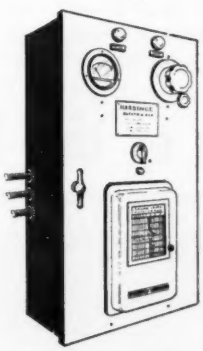

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NEWS and views

Kermac Nuclear Mill Dedicated

Dedication ceremonies were held recently for the new uranium ore concentrator mill, largest in the nation, of Kermac Nuclear Fuels Corp. The mill is situated in the Ambrosia Lake mining district north of Grants, N. M.

The mill, which went on stream November 28, has a rated capacity of 3630 tpd. It processes ore from two mines in production and will process ore from three more mines under development. Also, Kermac Nuclear purchases a limited amount of "custom" ore from independent operators.

U. S. Senator Robert S. Kerr of Oklahoma was featured speaker at the dedication. Other speakers on the program included Dean A. McGee, Kermac Nuclear president, and George H. Cobb, executive vice president. Senator Kerr is chairman of the board of directors of Kerr-McGee Oil Industries, Inc., which in 1956, together with Pacific Uranium Mines Co., Los Angeles, and Anderson Development Corp., Albuquerque, formed Kermac Nuclear Fuels Corp. by combining the Ambrosia Lake properties of the three companies.

The mill, constructed by Stearns-Rogers Manufacturing Co. at a cost of $18 million, operates on an acid leach, solvent extraction process. Kermac's mines and mill will employ more than 800 persons when full production is reached.

Kennecott To Buy Claims

Kennecott Copper Corp. announced that a subsidiary, Bear Creek Mining Co., intends to exercise options to purchase 120 mining claims near Safford, Ariz., for a price "in excess of $3,000,000."

The claims are held primarily by residents in the area and cover potential copper mining operations. They involve about 2000 acres in southeastern Arizona, in an area near two Phelps Dodge Corp. copper mines. The options extend into 1961 and certain legal requirements such as patenting the claims must be accomplished before they actually will be exercised.

No large scale operations are contemplated in the Safford area in the near future. Additional exploratory work is required before the company's plans for the property can be determined. Kennecott's interest in the Safford area is essentially in the nature of a long-term investment.

Cobalt Mine, Mill and Refinery To Close

Calera Mining Company's mine at Cobalt, Idaho, is scheduled to close the first part of June. The closure will result from fulfillment of a sales contract for cobalt with the Federal government.

Mining and milling operations have provided sufficient cobalt concentrates for the refinery operation at Magna, Utah, to fill the General Services Administration contract. The refinery will require about three months to process the intransit and inventory concentrates, and thereafter the plant will close, unless relief in a form adequate to sustain a profitable operation is immediately available.

The cobalt property is the only operation of its type in the western United States, and is one of the biggest producers of the critical metal in North America. Calera Mining is a subsidiary of Howe Sound Co., of New York, and in 1957 employed 450 men at the Idaho mine and mill.

Simplot Expands Activities

J. R. Simplot Co. of Boise will start erecting a $2,000,000 clay and silica refining plant at Bovill, Idaho, in the immediate future. A rock crushing plant has already been installed to provide aggregate for the plant and access roads, and an office building and laboratory have been completed.

The refinery will process kaolin clay which the company will mine by open-pit methods. Stripping of overburden is now underway. Production is scheduled to start late next fall. The company plans to mine more than 200,000 tons of clay per year which will produce about 100,000 tons of refined clay and the same amount of silica.

The clay will go mostly to the paper, ceramic and refractory brick industries, and the high-purity silica to glass manufacturers.

In other company developments, a long-term management agreement covering the operation of the Conda, Idaho, open pit phosphate mine has been worked out by Anaconda Co. and J. R. Simplot Co. In the future, Simplot will operate and manage the property, with production going to both Anaconda and the Simplot fertilizer division at Pocatello. The agreement will probably result in an increase in the rate of mining.

ALSO . . .

Idaho's Governor Robert E. Smylie has asked the chairman of the Western Governors' Mining Advisory Council to call a special meeting of the Council for July 8 and 9 at Sun Valley to study the serious situation facing the nonferrous and strategic metal mining industries of the Western States and Alaska.

Recommendations will be submitted to the various governors in advance of the meeting of the conference of western governors which is set for September 24–27 at Sun Valley.

A lease and option agreement with Stardust Mines, Inc., of Salt Lake City, to operate the Stardust quartzite building stone quarry near Baker, Nev., has been signed by United Park City Mines Co.

The tough ones...

come to Card

200 ROTARIES HAUL POTASH FOR INTERNATIONAL MINERALS & CHEMICAL CORP. POTASH DIVISION

Thirty new Rotary Dump cars recently placed in service bring to an even 200 the CARD Rotary Dump Mine Cars now in underground use at Carlsbad. Potash does not give the impact punishment CARD cars are taking in so many hard rock operations, but conditions are still tough.

Trains are long; haulage distances constantly increase; grades grow steeper. To keep in full operation economically, the cars have to be easy rolling, strong of frame, and solidly built against mild corrosion. All wheels are Timken bearing equipped and live rubber pads are used instead of conventional steel springs. They are 152 cu. ft. in capacity, struck measure, and track gauge is 42".

Aside from a heavier draft gear to meet the requirements of steeper grades and heavier trains, today's cars are little changed from those in the original order. Four re-orders over a period of years prove customer satisfaction at International Minerals & Chemical Corp.

You, too, can customize your haulage with an economical CARD design. Our engineers can furnish an efficient car to meet your most difficult specifications.

C.S. Card Iron Works Co.

2501 WEST 16TH AVE.
DENVER, COLORADO

Installation of oxygen converters to speed steel production and increase capacity at its Pueblo, Colo., plant is being studied by Colorado Fuel & Iron Corp. The first stage of the study is financing for the program, estimated to cost about $10,000,000 to $12,000,000. Oxygen converters turn out a batch of steel in one hour compared with seven to nine hours for open hearth furnaces such as CF&I now operates.

Plans to sink a five-compartment, 1000-ft shaft at its Daisy mine in Arizona's Pima district have been announced by Banner Mining Co. The new shaft will increase the productive capacity of the Daisy, which ships ores to the El Paso facilities of American Smelting & Refining Co.

For the fifth year the Chino Mines Division of Kennecott Copper Corp., Hurley, N. M., will award $5500 in scholarships to students in six southwestern colleges and universities.

Crews at the Conjecture mine near Lakeview, Idaho, have started exploration and development work from the newly completed shaft. Work is underway on both the 700 and 1000-ft levels. Federal Uranium Corp., of Salt Lake City, is doing the work under a profit-sharing agreement with Conjecture Mines, Inc. of Spokane. Federal's expenditures on the silver-lead property total about $900,000.

Deeper development of the Sunshine mine near Wallace, Idaho, is being planned. A study is being made to determine where to sink below the 4000-ft level which is about 1000 ft below sea level—the deepest horizon yet reached in the Coeur d'Alene mining district.

Sunshine Mining Co. has moved to its new headquarters building at 300 West Mission in Spokane.

Susquehanna-Western Inc. is the new name for Fremont Minerals, Inc., Denver-headquartered uranium milling company at Riverton, Wyo.

Ground was broken recently on a new 522-tpd, $3,000,000 uranium mill in Wyoming's Gas Hills District. Federal Uranium Corp., Radorock Resources, Inc. and Gas Hills Uranium Co. are affiliated in the project. A similar amount of capital will be expended in mine operations. Federal Uranium is the operator on the new project.

Committee Sets Program For Denver AMC Convention

E. I. Renouard accepts Program Committee Chairmanship

Top mining leaders are meeting in Denver during the week of June 15 to draw up the program agenda for the Metal Mining and Industrial Minerals Convention of the American Mining Congress to be held in Denver the week of September 13.

Under the leadership of Edward I. Renouard, vice president in charge of western operations, the Anaconda Co., and newly-appointed National Chairman of the A.M.C. Program Committee, a representative group of mining industry operators and executives is drawing up a comprehensive program to cover the most important developments in mining techniques and industry policy. Swiftly advancing technical progress and fast-changing economic and legislative climates leave no shortage of new, important material to be covered at this convention.

The program committee is including subjects covering the whole broad range of mining activities of interest to all miners —from the youngest shift boss on the production line, to the seasoned leaders who serve on executive staffs. Engineers in all phases of mining, geologists, mill men, educators, researchers, and supervisors at all levels will find material on the program that is designed to improve their job performance.

E. I. Renouard

Every miner who can possibly break away to attend the September 13 to 17 meeting should arrange for hotel reservations immediately. Send your application to AMC Housing Bureau, Denver Convention and Visitors Bureau, 225 West Colfax Ave., Denver, Colo.

IN MEMORIAM

Chester H. Steele, 65, vice president in charge of western operations, the Anaconda Co., passed away May 19 at Butte, Montana.

One of the industry's most respected and widely known leaders, Mr. Steele's wise counsel and warm friendship will be profoundly missed by all who have known him. Through his many professional accomplishments and his inspiration to associates in the mining industry, he leaves an indelible mark in the annals of mining progress.

At the time of his death Mr. Steele was chairman of the National Program Committee for the 1959 Metal Mining & Industrial Minerals Convention of the American Mining Congress.

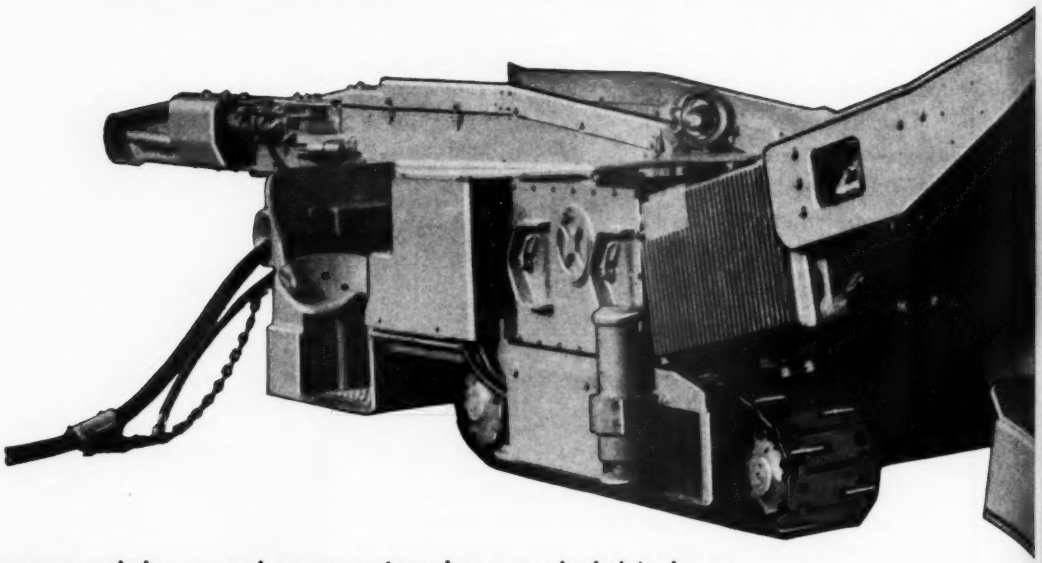
Chester Steele devoted his professional career to Anaconda, starting as a geologist in 1916. He headed the Butte geological department from 1948 until early 1952 when he was made general manager of western operations. In mid-1952 he was elected vice president in charge of western operations.

Chester H. Steele

POWER PACKED PROFIT

Lee-Norse CM37X and

The only miner that combines modern loading with advanced cutting techniques



- Continuous mining reaches spectacular new heights in operational efficiency with each of these new and exclusively engineered heavy duty Lee-Norse Miners.

- Now power-packed precision action teams with increased capacity and faster "overdrive" tramming speed to produce rapid-fire tonnage

PRODUCERS FOR 1959

CM47X... mining 42 inch to 10 foot heights

- *4 to 5 tons per minute*
- **Available for either AC or DC power**
- Three identical 50 h.p. conservative continuous rated motors, that require no water cooling.
- A 24″ flexible conveyor operates on hydraulically "no-clutch" gear motors applied to the gathering head.
- Controlled multiple tramming speed — variable to 50 feet per minute, with "overdrive" at 90-100 feet per minute.

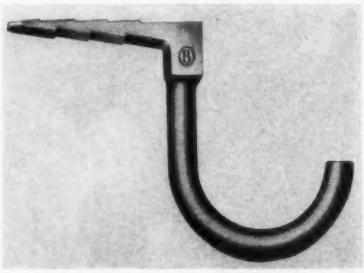
LN **Lee-Norse Company**
CHARLEROI, PENNA.
Specialists in Coal Mining Equipment

Coal high or low?... Lee-Norse MINERS keep production on the go!

manufacturers forum

Roof Plate Hooks

QUICK AND CONVENIENT SUPPORT from bolted roof of trailing cables or pipe up to 2½ in. in diam can be accomplished by means



of a new roof plate hook, according to Ohio Brass Co., of Mansfield, Ohio. It is made of malleable iron and is installed by hammering the serrated arm between plate and roof to make a strong, rigid support which can be recovered and used again.

Heavy-Duty Apron

FOR USE IN ROCKY CONDITIONS, Caterpillar Tractor Co., Peoria, Ill., announces a heavy-duty apron as optional equipment with the Caterpillar No. 456 and No. 470 (Series B) scrapers. The two scrapers are 19.5 cu yd (struck capacity) units designed for the DW20 and DW21 tractors.

The apron reportedly has been designed especially to resist the damage which can result from hard usage in rough, rocky material, and helps in greatly reducing the bending, denting and distorting common to standard aprons in rocky operations. New steels and stronger construction are said to enable the apron to withstand the usual buffeting.

Large Agitators for Ore Processing

TWENTY THREE of the largest agitators for ore processing ever produced in the United States are to be installed in the first section of a $133,000,000 aluminum processing plant in Guinea, West Africa, according to Denver Equipment Co., P. O. Box 5268, Denver 17, Colo. The equipment was purchased from the Denver company by the newly-formed Fria Compagnie Internationele Pour la Production on De L'Alumine, described as a cartel of private American, French, British, Swiss and West German interests.

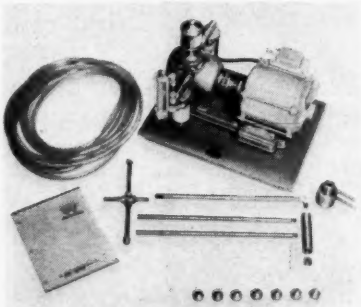
Seventeen of the 23 agitators have 96-in. diameter propellers. They are to be used in chemical tanks that are 21 ft long and 20 ft deep. The bauxite ore is minus eight mesh and the pulp is 18 percent solids. In such a large tank it is possible to keep solids uniformly in suspension only with the positive action of propeller agitation.

In addition to the large diameter propeller design, the worm gear drive that powers the propeller also incorporates certain distinctive features. The mechanism has a massive main shaft and wide spaced bearings to withstand the cantilever loading imposed on long shaft agitators.

A. C. Daman, DECO president, believes, "these big propeller agitators open a vast new field in mineral processing since it is now possible to maintain solids in suspension in large holding tanks.

Dust Sampler

TO MEASURE DUST PARTICLES discharged from dust control equipment and to determine equipment operating efficiency, The DAY Co., 810 Third Ave., N. E., Minneapolis 13, Minn., has designed an Iso-

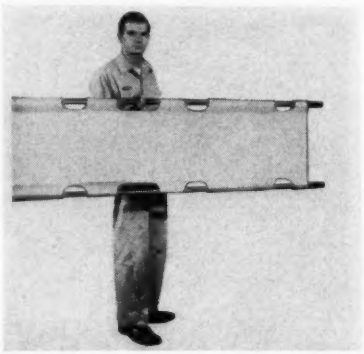


Kinetic Dust Sampler. This equipment, used by DAY for many years in conducting field tests to determine dust conditions, is now available to companies who wish to conduct their own dust control measurements.

Lightweight Folder Stretcher

WEIGHING 7¼ lb and capable of supporting more than 400 lb, MSco UtiliPort is a lightweight stretcher now available from Medical Supply Co., Rockford, Ill., and CAMESCO Medical Supplies Ltd., Toronto 18, Canada.

Although it is 6 ft 2 in. in length when unfolded it takes up,



upon folding, only 37 in. by 3 in. of storage space. Special hinge sleeves are said to assure positive locking for use. It is made of aircraft-type aluminum tubing and abrasion-resistant vinyl-impregnated nylon which leaves it unaffected by moisture and re-resistant to gases or flame.

Fire Resistant Hydraulic Fluid

A WATER-IN-OIL EMULSION type fluid developed by Shell Research with the full cooperation and encouragement of U. S. Bureau of Mines claims to put a virtual end to serious worker injury and costly property damage resulting from hydraulic oil fires in mines.

Described as the world's first economically-priced fire resistant hydraulic fluid, it is designed specifically for use in all types of hydraulically-operated mine machinery. Known as "3XF Mine Fluid" it has a built-in "fire extinguisher" which smothers fires before they can get started.

Initial laboratory testing of this fluid has been followed by thousands of hours of operation under actual mining conditions.

Electrode Holder

A PISTOL GRIP holder for arc welders electrodes has been announced by Frank Niemi Metal Products, Inc., Gurnee, Ill. The holder has a molded pistol grip, with a built-in safety cut-out to prevent accidental "flashes" or shocks—the instant grip is released, current is off. Another reported advantage of the Handi-Arc Electrode Holder is its tip grip on electrodes which permits use of electrodes down to a short stub. The milled copper jaws are adjustable to accommodate rods of different diameters and the case is made of high impact phenolic plastic. All working parts are of machined copper and a receptacle is found in the handle for self clamping attachment of lead cord.

Hose Assembly Machine

A POWER machine for speeding up assembly of reusable Hoze-lok fittings onto industrial rubber or cotton covered, wire or fabric braided hose, Model 422 is portable and weighs approximately 160 lb. The unit is driven by a ½-hp, 60-cycle electric motor and readily handles hose ranging in size from ¼ through 1⅜ in. inside diameter. Complete operation and maintenance instructions are offered in Catalog 4407-A14, available from W. D. Wynant, Parker Fittings & Hose Division, Parker-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, Ohio.

Crawler-Mounted Tractor

GREATER POWER, decreased maintenance requirements and higher lugging ability, are claimed for the D7 Series D tractor. According to Caterpillar Tractor Co., Peoria, Ill., the D7's engine develops a 140 flywheel hp, an increase of more than nine percent over the rating of its predecessor. Drawbar horsepower has been increased from 102 to 112. In first gear, the tractor is rated at 27,100 lb drawbar pull. However, under load the drawbar pounds pull increases to 33,250. Other reported features include lifetime lubricated rollers, carrier rollers, and idlers, with the exclusive floating-ring seal.

Plastic Valves

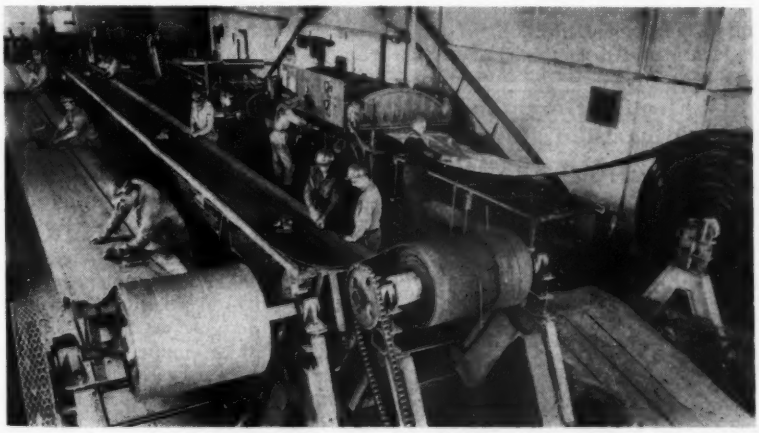
WITH THE ADDITION OF THREE SIZES—¼, ⅜ and 1¼ in. —to its rigid PVC (polyvinyl chloride) Y-globe valves, check valves and strainers, the Walworth Co., 750 Third Ave., New York, N. Y., is now in a position to offer these products in a complete range of sizes from ¼ to 2 in. PVC products are said to offer exceptional resistance to inorganic salts, alkalis, acids and other corrosive fluids. The Y-globe valves, check valves and strainers reportedly operate successfully at pressures to 150 psi at 75°F.

Crane

THE 45-TON model 30-B Transit Crane can lift a maximum load of 45 tons with a 40-ft boom at a radius of 15 ft, according to Bucyrus-Erie Co., South Milwaukee, Wis. The machine can be used as a 1 to 1½-yd hoe, 1 to 1¾-yd shovel, 1 to 1½-yd dragline and as a clamshell. The crane, which will reach 140 ft with jib, has a boom fabricated of Tri-Ten steel; an air-operated boom hoist and engine master clutch to complement the 30-B's air-control system; adjustable cone rollers, and a 6 by 4 or 8 by 4 carrier with gas or diesel engine.

Hose Reel

FOR HANDLING 2½-IN. DIAMETER NON-COLLAPSING HOSE, the reel has a 150-ft hose capacity and is a new member of the Ardmore family of reels available in capacities up to 700 ft for larger diameter hose. The unit is designed for indoor or outdoor platform mounting and the cabinet provides weather-tight closure. Driven by an electric motor, the reel measures 44½ in. by 61 in. by 54½ in. high over-all and carries a 48-in. diam. drum. For complete information write for Data Sheet 150 to Ardmore Products, 1825 Shermer Road, Northbrook, Ill.



BELT REPAIR AND MAINTENANCE

A BADLY DAMAGED CONVEYOR BELT is a serious and costly problem—a problem that often has to be faced by operations which rely on conveyors for materials handling. Some ten years ago W. A. Mars, now president of Conveyor Belt Service, Inc., located in Virginia, Minn., applied himself to this problem when he became impressed with the fact that thousands of feet of belt were being scrapped before they were worn out. After nearly five years of study and research, he developed an operation designed to repair conveyor belts on a continuous basis. The repair process relies on careful stripping away and replacement of damaged and worn ply material, thorough drying and curing and vulcanizing in a specially adapted vulcanizing platen press.

With the development of a satisfactory repair process, Mars outfitted a belt repair plant and received his first order in late 1953. He convinced the operators of a Mesabi open pit mine that they should try to repair a damaged pit belt rather than replace it. The belt would have cost more than $15,000 to replace. CBS, Inc., repaired it for $6,000. Since repair, the belt has hauled more than 8,000,000 tons of material and is still in good condition.

Since its first successful belt repair job, the company has handled almost every type of belt and repaired every conceivable type of damage. A tear 2200 ft long in one belt was repaired in a matter of 18 days. Another 1600-ft belt from a limestone quarry in Iowa was back in service in less than three weeks after the company received it. A ⅜-in. top cover, steel cable belt was completely ripped for a length of 500 ft. CBS, Inc., tackled the problem, repairing the belt at a third of the cost required to replace it. A 36-in. belt, hauling material in a Colorado uranium mine, was badly torn and the company completely renovated and repaired this belt for a cost of $2200, thus saving the operator nearly $3000.

Conveyor belts have come to the Virginia plant from all over the country and from many different types of operations. The company has also repaired belts from operations in Saskatchewan and Ontario, and recently a belt was received for repair from a mining operation in Venezuela.

Conveyor belt repair is relatively new. However, Mars feels that as more operators realize that belts can be restored to new life, and at a saving, the practice will become widely accepted throughout the country.

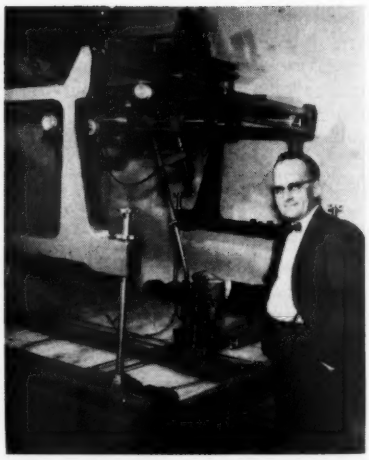
Automatic Scanning Correlator

THE AUTOMATIC DRAWING OF CONTOUR LINES showing ground elevations has been realized by "Stereomat", an instrument developed by Hunting Associates Ltd.

The device replaces the human operator in the delicate and fatiguing task of establishing contours on photogrammetric maps made from aerial photography. It promises benefits to mining, heavy construction and other industries requiring fast and accurate mapping service and also has tremendous potential in resources explorations and in civilian and military mapmaking.

It employs a complex array of electronic, optical and mechanical gadgets to trace correct contour lines in conjunction with a "stereoplotter" —another machine which allows nearly-identical aerial photographs to be viewed in precise relationship for three-dimensional effect.

Hunting Associates, Ltd., 1450 O'Connor Drive, Toronto, Canada, from whom further information can be obtained upon request, says that Stereomat will be manufactured under license in the United States by Benson-Lehner Corp., of Los Angeles, Calif.



Electric Dozer and Mine Roof Bolter

WITH MOTORS AND SWITCH GEARS approved for gassy coal mine use, Eimco Corp., P. O. Box 300, Salt Lake City 10, Utah, announces the production and development of its new electric dozer and mine roof bolter.

Designated Eimco Model 637, it operates on a-c or d-c motors which drive the pumps providing hydraulic power to independently activated tracks and to the dozer, drill boom and cable reel.

Dozing is possible in less than five ft of headroom as the boom permits 50° lateral movement and folds back when not in use.

Drill

THE HYDRAULICALLY OPERATED, completely self-contained injector drill meets all the needs in the field for any type of rotary drilling operation in its class, according to Houston Tool Co., Santa Susana, Ventura County, Calif. The Houston-Hi-Vac Injector Drill, Model H. D. 250, drills in six different ways: (1) vacuum, (2) reversed water or mud drilling, (3) standard forced water or mud drilling, (4) diamond drilling by vacuum or water, (5) standard continuous flight auger drilling, and (6) compaction test drilling. Weighing 1800 lb, the drill, which reportedly will drill at any angle in any kind of formation, can be mounted in any four wheel ¾-ton pickup, truck or on a tandem wheel trailer.

Semi-Automatic Transmission

ENGINEERED FOR TRACTORS AND TRUCKS equipped with engines of up to 1160 cu in. piston displacement, the R-1160 RoadRanger transmission is designed to handle up to 800 lb per ft of engine torque. Featuring nine forward ratios, the R-1160 is built to give fast work cycles, low fuel consumption, longer engine life, reduced road maintenance and lowered operator fatigue, according to Fuller Manufacturing Co., Kalamazoo, Mich.

Repair Kit

FOR INDUSTRIAL MAINTENANCE REPAIRS, the Old Pro Kit is now available from Taylor & Art, Inc., Plastics, 1710 E. 12th St., Oakland 6, Calif. Kit contains fiberglass cloth and liquid and paste plastic compounds which solidify to adhere and lend strength to fractures, tears, holes, and dents in metal, wood, plastic, concrete, ceramic and other materials.

Lightweight Portable Air Hoists

TO CONSERVE TIME, reduce operating costs, and remove pressure from the busy shop crane, Ingersoll-Rand Co. has developed two lightweight, portable, air hoists, designed to be easily moved and installed by one man.

The 1000-lb capacity hoist weighs 39 lb and lifts its rated load at 45 fpm. The 2000-lb hoist weighs 56 lb and lifts its rated load at 22 fpm. The size MR and ML hoists are streamlined in appearance with a lightweight, aluminum alloy housing which measures 12½ in. in overall length, and 5¼ in. in diameter.

Several unique features are said to provide safety for the operator and easy control of the hoist. A mechanically operated brake is automatically applied whenever the controls are released. If the air supply should be shut off, the lowering of the load may be controlled by the brake. Safety-up-and down stops prevent damage to the hoist from overrun of the chain in either direction.

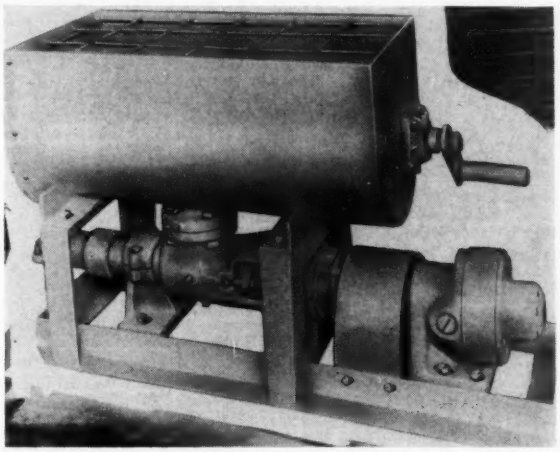
For further information write to Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

ORE CARRIER

APPROVED BY U. S. BUREAU OF MINES, the Getman Scoot-Crete Ore Carrier is manufactured by Getman Brothers of South Haven, Mich. The unit is powered by Continental diesel engines or by Dentz air-cooled diesel engines, and its speed is from 1 to 15 mph forward or reverse. With caster steering, the Scoot-Crete turns in its own length and reportedly can climb grades up to 25°.

Rock Duster

TO SATISFY IMMEDIATE ROCK DUSTING REQUIREMENTS in limited work areas of coal mines, the M-S-A Model 80 Slurry Rock Dust Distributor for machine mounting is now being marketed by Mine Safety Appliances Co., Pittsburgh, Pa.



The rock duster is said to be designed for permanent mounting on any mining machine, including a continuous mining machine, loading and cutting machines, roof bolter, coal drill and similar motor-powered equipment. When attached to any unit which furnishes one hp, the duster can be powered either mechanically or hydraulically direct from the mining machine.

Model 80 has a tank capacity of 80 lb of rock dust to 4.8 gal of water and reportedly delivers one complete batch in 3½ minutes at a discharge rate of 50 lb per minute.

Stopping Device for Grinding Mills

NEEDLESS MOTOR WEAR AND STRAIN is eliminated with a new patented stopping device for grinding mills, according to Allis-Chalmers.

Designed to make it possible to stop the mill in position for manhole access, the device will enable operators to cut servicing downtime. It consists of a magnetic limit switch attached to a non-moving part of the mill and a magnetic operator installed on the revolving frame. The limit switch is wired into the same circuit as the push button station that controls the starting and stopping of the mill. When the magnet revolves past the switch, the button is pushed and the circuit is interrupted. The new stopping device may be installed on any grinding mill now in the field.

Further information can be obtained by writing to Allis-Chalmers Manufacturing Co., Industrial News Bureau, Milwaukee 1, Wis.

—ANNOUNCEMENTS—

Chicago Pneumatic Tool Co. has acquired by cash purchase the assets of the **Reich Bros. Manufacturing Co., Inc.** of Terre Haute, Ind. producers of the internationally known Reich line of truck and crawler-mounted hydraulic rotary blast hole drills, and drilling rigs for down-the-hole blast hole operations. The purchase also includes Reichdrill Manufacturing Company, Ltd., Glasgow, Scotland.

The present personnel of the acquired organization, which will be called the **REICHdrill Division** of the Chicago Pneumatic Tool Co., will continue in their present capacities. Engineering and production operations will remain in the Terre Haute plant and all sales and manufacturing operations in Great Britain will be continued.

John R. Burkett has been appointed general sales manager for **American Cyanamid Company's** Explosives and Mining Chemicals Department. Burkett will direct commercial operations of the department's newly formed regional sales organization. He will make his headquarters in New York.

E. C. Farrar has been named eastern regional manager and **O. R. Brown,** western regional manager, reporting to Burkett. Farrar will be located in Latrobe, Pa. and will be responsible for sales in the eastern half of the country. Brown will have offices in Salt Lake City, Utah, covering sales in the west.

Van H. Leichliter, president of the American Steel & Wire Division, **United States Steel Corp,** has been named as one of five winners of a Distinguished Alumnus Award of Pennsylvania State University being conferred on June 13.

Leichliter joined American Steel & Wire on his graduation from Penn State in 1930. He was named president of the division in 1956.

The appointment of **National Lead Co.** as sales agent for the distribution of Bunker Hill zinc-base alloys in the United States, excluding the West Coast area, has been announced by **Bunker Hill Co.** and **National Lead.** Bunker Hill will market the zinc-base alloys on the West Coast.

R. T. Hair has been appointed to the newly established position of general sales manager, Coal Machinery Division, **Joy Manufacturing Co.** He was previously the division's sales manager.

Lawrence D. Gent, former manager of the Pittsburgh district sales office, was appointed sales manager, coal industry, with Pittsburgh headquarters, and he is being succeeded in his former post by **Ralph M. Hippard.**

CATALOGS & BULLETINS

COAL PREPARATION MANUAL. *The McNally Pittsburg Mfg. Corp., Pittsburg, Kans.* The pocket size coal preparation manual No. 559 gives descriptive information pertinent to the company's coal preparation and coal handling equipment. It contains complete descriptions with photographs, dimensional drawings and capacities of each unit and also has essential engineering data and reference tables.

SCRAPER AND REAR DUMP. *Advertising Dept., Euclid Division, General Motors Corp., Cleveland 17, Ohio.* The 16-page folder, Form No. 511, features the Model S-18 Scraper of 21-cu yd struck capacity. The folder is well illustrated with cutaway and exploded views of major components with special emphasis on operation, servicing and the power train consisting of four-speed Torqmatic drive with converter lock-up. An eight-page catalog, Form 151R4, on the model R-10 Euclid Rear Dump of ten-ton payload capacity is also available. This hauler, smallest in the Euclid line of off-highway rear dumps, is said to incorporate many improvements over earlier models and can be supplied with standard or quarry body.

AIR MOTORS. *Joy Manufacturing Co., Oliver Bldg., Pittsburgh 22, Pa.* Twelve models of the company's line of Piston air motors are described. Motors range from 1½ to 20 hp and have output shaft speeds from 19 to 800 rpm at rated horsepower. Direct drive models with standard flange, NEMA D flange or foot mountings and geared drive models with foot mountings are shown. Complete specifications, dimension drawings, torque and horsepower curves, throttle variations and a cutaway illustration are included.

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BLASTING VIBRATIONS. *Hercules Powder Co., Wilmington 99, Del.* Instructional film explains what goes on in the earth when explosives are set off, and how this affects structures. In one sequence in the film, a portable seismograph is used to show that a dynamite blast produces less vibration than a door slamming, or high heels walking across a kitchen floor.

CRUSHERS. *Nordberg Mfg. Co., Milwaukee, Wis.* Bulletin No. 236A features the Symons Intermediate Cone Crushers. These crushers are built in 22 in. and 30 in. sizes with fine or coarse type crushing cavities for second and third stage reduction crushing. Included is a table giving average capacities at various settings and feed openings.

ELECTRIC CAP LAMP. *Mine Safety Appliances Co., 201 North Braddock Ave., Pittsburgh 8, Pa.* M-S-A Bulletin No. 0201-5 covers the latest improvements to the Edison R-4 electric cap lamp. Reviewed are cap lamp components that lend themselves to improved safety, better illumination and more satisfactory battery maintenance. Discussed in detail are functional advantages of the two-filament Edison R-4 bulb. Included are a discussion and illustrations on the adaptability of the Edison R-4 electric cap lamp to either the automatic low-voltage charging system or the series charging method.

HOISTS AND CRANES. *Wright Hoist Division, American Chain & Cable Co., Inc., York, Pa.* Bulletin DH-28 illustrates the Wright line of motor-operated hoists, hand-operated hoists, jib cranes, hand-traveling cranes and motor-driven cranes. The eight-page folder contains data on general features, construction, details, weights, dimensions, suspension, specifications, clearances, accessibility and other information for plant operators.

V-BELT DRIVES. *Dodge Manufacturing Corp., Mishawaka, Ind.* Illustrated with photographs and engineering drawings, bulletin A695 explains construction features of Dyna-V sheaves and V-belts. The V-belt drives are said to be smaller, weigh less and require less space than conventional V-belt drives. Tables of pre-engineered drives make this an easy-to-use manual for plant engineers, design engineers and other users with power transmission problems. Other tables give horsepower capacities, belt speeds, center distances and sheave diameters. Photographs illustrate easy-on, easy-off characteristics of Taper-Lock bushings featured in new line.

MOTOR GRADERS AND ROAD ROLLERS. *Huber-Warco Co., Marion, Ohio.* Booklet HWG-561 outlines the features of nine motor grader models ranging from 75 to 195 hp, tandem and three-wheel rollers, and the M-52 Maintainer that performs nine maintenance jobs.

VIBRATING CAR SHAKER. *Syntron Co., 703 Lexington Ave., Homer City, Pa.* Data sheet presents the latest revisions on Syntron's recently introduced unbalanced-motor vibrating car shaker. It reportedly is designed to accomplish the rapid emptying of railroad hopper cars without damaging the cars. Illustrated data sheet gives complete description, electrical and mechanical data and specifications.

INDUSTRIAL TRUCKS SELECTOR GUIDE. *Automatic Transportation Co., 149 West 87th St., Chicago 21, Ill.* Booklet reportedly will be of assistance to all material handling men in setting up new or revising present system in relation to their specific plant problems. Over 150 models are illustrated. The selection factors—such as capacity, frequency of use, power source and use of semi-standard or special trucks—are also given as a ready reference to all Automatic industrial trucks.

PUMPS. *Dorr-Oliver Inc., Havemeyer Lane, Stamford, Conn.* Five equipment bulletins have been bound in a single catalog entitled, "Dorr-Oliver Pumps for Hot or Cold Corrosive and Slurry Service." Containing 22 pages, the catalog describes the complete D-O pump line for chemical process and allied industries. Included are line and wash drawings, photographs, specifications and performance data, and parts lists.

OPTICAL PRODUCTS. *Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.* Catalog L-86 is a 24-page illustrated index which lists current Bausch & Lomb catalogs. It is divided into consumer, ophthalmic and scientific and technical products classifications, corresponding to the major product division of the company. This permits catalogs of allied products to be grouped together for quick, easy reference. Each catalog entry includes a cover illustration and brief descriptive data.

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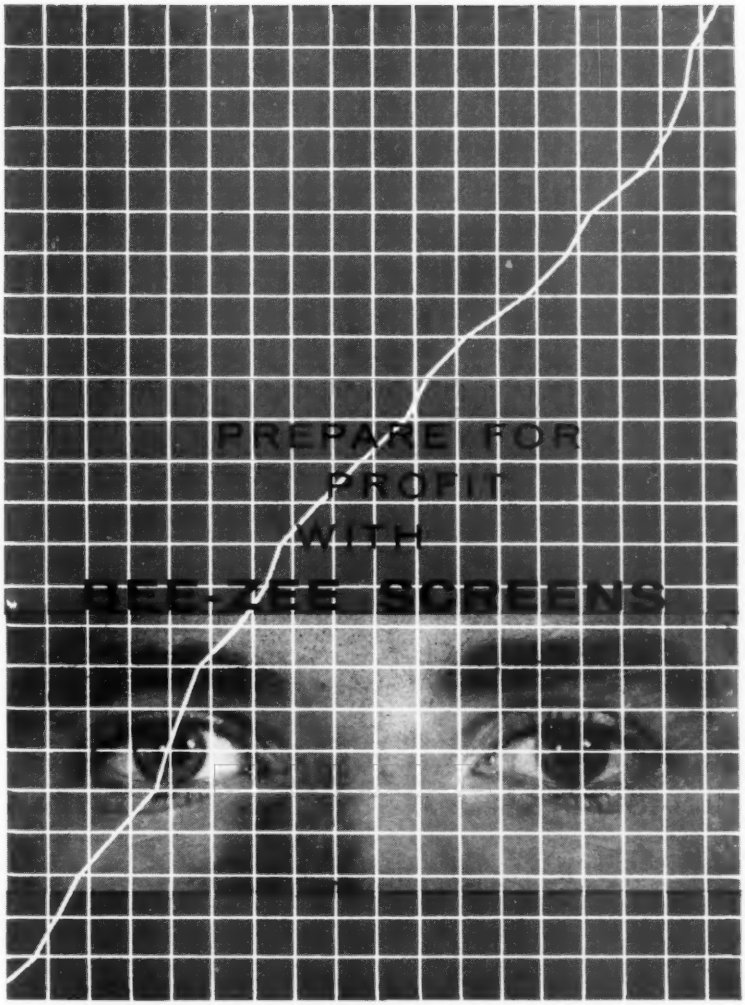

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